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"ELECTRICAL REVIEW."

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THE EMPLOYMENT OF PROFESSIONAL MEN IN FACTORIES.

ALTHOUGH it deals more immediately with the sister science of chemistry, the letter from Sir William Ramsay, published in the *Times* of October 12th, interests us not a little, partly because it adduces new arguments in support of the contention we have so often urged in this connection, and partly because its authorship, manner, and place of publicity are likely to bring the statements home to the people whom they most nearly touch. Sir William asserts that we are producing trained engineers and chemists quite as capable and inventive as our German competitors, but that the prospect of a reasonably remunerative career is generally wanting in this country. While in Germany there is a fairly lucrative career for a young chemist, in England, although there will soon be many well-trained men, the openings are few. Sir William, it will be observed, speaks in the future tense of highly-skilled British chemists. To a large extent he is no doubt correct here; but if it would not be quite justifiable to generalise so broadly in the present tense, the fault, as we have repeatedly argued, and as Sir William implicates, is that of our manufacturers, who do not encourage lads and their parents to expect salaries commensurate with the interest on the money sunk in a lengthy scientific education. Sir William Ramsay shows how the average British manufacturer who is making a good profit in his business only lives in the past, does not care to prepare new articles, does not know that there are newer and better ways of making the old ones, and so is content to get along with as little skilled assistance as possible. When the fact leaks out that he is trading successfully, rival works are started, prices go down, and with falling profits it is too late for him to do other than cut down expenses, in which process the scientific staff, if any, is pruned first. Moreover, when such an one does employ qualified assistants, he rarely has more than one or two; and the unfortunate chemist (electrician or engineer) is deemed incompetent if he cannot be at once the analyst of raw and finished materials, the works manager, and the discoverer of new processes and things to make. Apart from the very obvious fact that the solitary chemist in a large business has not time to attend properly to any one of these branches without more or less neglecting the other two, the three positions, or at least the works managership and the laboratory work, demand different types of man for their efficient fulfilment. A works manager, we believe, is, to some extent, born rather than made; but at any rate, the training or experience requisite is of no service (if not a specific hindrance) to him inside the laboratory; unless, possessing unusual versatility and breadth of mind, his duties in the laboratory are limited to the control and inspiration of subordinate trained chemists.

Sir William Ramsay instances a factory in Germany—not

a mere overgrown laboratory, so to say, where only "fine chemicals" are made, but a concern selling not less than 100 tons of each product annually—where 70 chemists, mostly trained in Universities, are regularly employed. Of these 20 are analysts, 25 departmental works managers, and 25 are exclusively engaged in research, *i.e.*, in devising new processes of manufacture, investigating new products, and in testing new methods submitted by outside inventors. Students who have just graduated, however, are not accepted for this branch until they have carried out some piece of research beside that needed for their thesis; they must have acted as assistants to professors in universities or in polytechnika. Each new assistant enters into a five years' contract with the firm, the initial salary being £120 to £150, and rising to £250 by the end of the term. If mutually agreeable, a fresh contract is then made for another five years, the salary being increased to £350, and, as a rule, a share in the profits being also given. After the tenth year a special arrangement may be made by which, as salary and profits, he receives some £1,000 per annum or more. The best of these men, too, frequently receive a call to a chair in a university or polytechnikum; and conversely, it is common for a company to offer a lucrative post to the occupant of such chair, although he may have had no previous technical experience. This interchange is clearly most advantageous to both parties, for it establishes that close bond between teaching and practice which is a crying want in this country.

Sir William Ramsay makes a good point in his letter which should appeal to his non-scientific readers. Our specialised training establishments are turning out numbers of pupils every year, the supply being largely stimulated by the scholarships given by County Councils. Some of these lads are technical failures, and they should be incontinently ungowned and left to the desk, counter or bench. Many of the lads, however, give promise of special aptitude; but since they have been educated at the public expense, the public might advantageously look a little further ahead than is customary, and inquire what is the good of sinking all this money in brains?

Indeed, though we say it with regret, this want of forethought is by no means confined to our non-technical citizens. Some of our men of science are crying out for better or more numerous educational establishments, and for the funds necessary to endow them—most worthy causes, we are anxious to admit—which, if brought into existence, shall vastly increase the quantity, and, we hope, somewhat increase the quality, of the finished students turned out in a given time. But we have a distinct suspicion that in present circumstances this would be an almost unwarrantable interference with the law of supply and demand—certainly in quantity, if not in quality—and before we can altogether countenance these proposals we must be persuaded that our capitalists and manufacturers are as ready to increase the demand for such technicians as our improved colleges will be to increase the supply. A youth of sound scientific training, unable to obtain a proper situation, may make a better assistant in a purely commercial house, perhaps, than the average Board School clerk; but even if this assumption is warrantable, such a process for preparing clerks would be unnecessarily tedious and expensive.

Municipal Tyranny.

One of the principal distinctions between the conduct of a trading undertaking by a municipality and by a private company, lies in this fact—that, whereas the members of the latter are engaged in business with the honest and avowed purpose of making for themselves a financial profit, the former are ostensibly actuated solely by the desire to benefit their fellow-men—the ratepayers whom they represent. The motive is an honourable one; and if it were the only one, as it should be, much of the objection to municipal trading would be annihilated. Unfortunately this praiseworthy ideal is but seldom attained; too often some, at least, of the members of a council are impelled by motives such as blind prejudice against private enterprise, the desire to gratify personal ambition, or the lust for power. Apart from the lack of the special knowledge, which is indispensable in the conduct of highly technical undertakings, such as the supply of electricity, these unworthy motives clog the wheels of progress, and exert a most detrimental influence upon the fortunes of the projects controlled by their possessors.

It is also true that, in many cases, thanks to the careless indifference of the electors, their representatives include members who do not hesitate to stoop to unworthy expedients to gain their secret ends, utterly regardless of the welfare of others, who may suffer injury through their machinations; pitiable is the lot of their victims!

It has been our unpleasant duty heretofore to call attention to the conduct of the Electricity Committee of the Corporation of Manchester. Far be it from us to suggest that many of its members are unworthy of their office; it is, however, a regrettable fact that all are not equally above reproach, and this has once more been clearly demonstrated by recent proceedings on the part of the Committee. It will be remembered that the latter, by its ceaseless persecution, drove the first city electrical engineer, Mr. Wordingham, to resignation, and so delayed the extension of the works through its unwarranted inter-meddling with his plans, that serious loss was incurred, and great inconvenience imposed upon would-be consumers. Having also ousted its chairman, the then Lord Mayor elect, the Committee endeavoured to remedy its faults by employing the highest professional advice at great expense, and carrying out urgent works of extension. Its next step was to remove its new chairman, at the instigation of one of the members. Soon after, an agitation was fomented, directed against the present electrical engineer, with a view to showing that the further extensions, for which he was responsible, were of excessive magnitude; this movement, which sprang from the same source, ended in a verdict in favour of Mr. Metzger. Now, however, a final disagreement has resulted in his resignation, in disgust — exactly as befell his predecessor, Mr. Wordingham.

The circumstances were as follows:—In June last Mr. Metzger was invited by the Burslem Corporation to report on the merits of certain tenders; before taking any other step, Mr. Metzger obtained the written consent of his chairman to accept the invitation. In July Mr. Metzger was again approached, this time to arbitrate in a dispute on a technical matter, and once more he received the chairman's permission to act. In both instances the work was done in his spare time, and the chairman was fully informed of the nature of the work in detail. We understand that the agreement signed by Mr. Metzger contained no clause prohibiting him from taking private work, or even specifying that the whole of his time should be devoted to the Corporation, the common formula of such agreements. A short time ago, however, the matter was sprung upon the Committee as a gross dereliction of duty; the Committee resolved that

there had been a misunderstanding as to the terms of the agreement, and that the question should be dropped, subject to a new agreement being drawn up, stating clearly that private practice would not be allowed in future. To this Mr. Metzger consented, for the sake of peace. But the deputy-chairman, who had raised the question in the first instance, and found himself supported by only two out of twenty members, objected to this course, and declared that if it were adopted, he would make the matter public, a proceeding fraught with intense discomfort to the Committee, already satiate with scandals; and the Committee was dumbfounded. At this juncture Mr. Metzger came to the rescue; foreseeing that, like his predecessor, even if this trouble were overcome, perpetual persecution would be his lot, he summarily resigned. The Committee weakly accepted his resignation, to save itself from the threatened scandal, and adopted the engineer as a scapegoat.

We cannot blame Mr. Metzger for his decision. We are too well acquainted with Manchester municipal manners to suppose that persecution and worry will ever be omitted from the reward of the harassed city electrical engineer, and he is well out of it. But is it not clear that the undertaking is not carried on for the sole benefit of the citizens? It is not proper business management to allow the chief to leave when a huge scheme of extension is being carried out—to leave, be it noted, on account of no technical deficiency; no suggestion has been made in any way reflecting on the engineering ability of Mr. Metzger, and his resignation has been accepted merely to satisfy the caprice of two or three obtrusive members. And is it not curious that these occurrences take place on the eve of the November elections, when new Committees—and chairmen of Committees—are appointed? The blame, if any were deserved, lay with the chairman for granting permission to do the work; but having regard to the terms of the agreement, we fail to see that even his permission was required. As a matter of courtesy, no doubt Mr. Metzger was strictly correct in consulting the chairman in the matter—but he was under no obligation to do so.

The Treatment of Cancer by Electric Osmose.

An interesting article by Mr. Wright, F.R.C.S., on the treatment of cancer and other forms of malignant disease appears in the *Lancet*, September 12th. Drugs were introduced into the tissues of the diseased part by electric osmose produced by a high frequency alternating current. Leduc has proved by means of coloured ions—a solution of permanganate of potash—that the medicaments introduced by electric osmose do not merely pass into the subcutaneous areolar tissue, but directly penetrate into glandular organs and other structures more deeply situated. Frankenhaüsar has shown that the amount of medicament absorbed and the depth to which it penetrates have a constant relation, the former to the quantity and the latter to the intensity of the current employed. This process is evidently a very effective means of bringing drugs directly into contact with diseased parts not too deeply seated. In 22 per cent of the cases of cancer treated by Mr. Wright the treatment was successful. He has personally come to the conclusion that "a radio-active salt of strontium introduced into the tissues by cataphoresis by high frequency, will prove the desired panacea of all forms of malignant disease."

Epsom Lighting. — The R.D.C. considered a letter from the Surrey Electrical Power Distribution Co. applying for consent to the granting of a provisional order to supply energy to the parishes of Cheam, Cuddington and Ewell upon the same terms and at the same prices as had been accepted by Sutton. Upon that understanding the clerk was directed to reply that the application would be favourably considered.

MOTOR-GENERATORS AND ROTARY CONVERTERS.

By H. M. HOBART.

(*Continued from page* 529.)

The next step is to investigate the performance of the rotary converter when thus adjusted. The rotary converter is to be operated from the secondaries of transformers whose

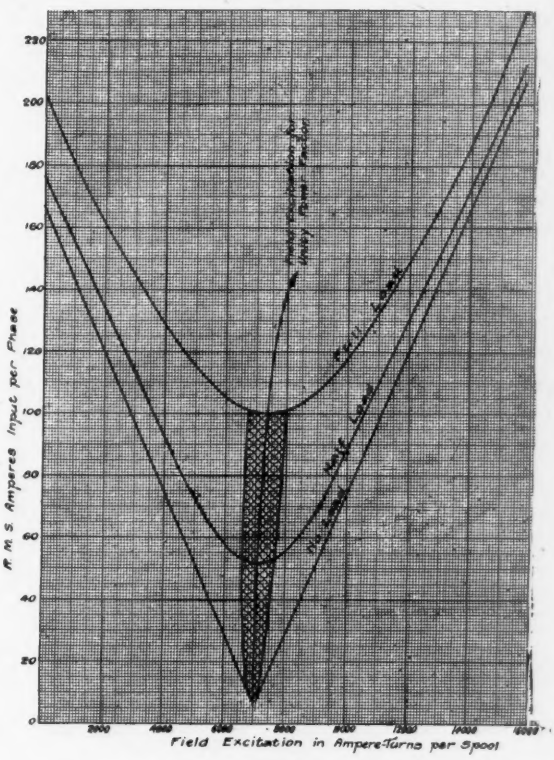


Fig. 8.

primaries are fed over a high-tension line. But for convenience of calculation the resistances and voltages will be reduced to the equivalent Y voltage of the rotary converter.

At no load the Y voltage at the slip-rings of the rotary converter is

$$\frac{600 \times \cdot 615}{\sqrt{3}} = 213 \text{ volts.}$$

First assume that in transmission line, step-down transformers, and rotary converters, the equivalent resistance and the equivalent reactance are each equal to 0·01 ohm per phase. It is required to determine the voltage at the central station in order to obtain 600 volts at the commutator at no load. From fig. 8 the input per phase is found to be 640 amperes and is practically wholly wattless. Hence

Reactance voltage per phase = 640 × 0·01 = 6·4 volts.
Resistance " " " = 640 × 0·01 = 6·4 "

Constructing the diagram in fig. 10, the equivalent voltage

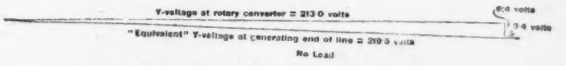


Fig. 10.

at the generating end of the line is found to be equal to 219·5 volts.

∴ At 219·5 volts at the generating end of the line, the no load commutator voltage is equal to 600 volts.

In fig. 11 is given the corresponding diagram for half load, the potential at the generating end being maintained constant at the value of 219·5 volts derived at no load. From the phase characteristic at half load in fig. 8, the total

current input per phase is found to be 530 amperes, and the minimum value of the curve, 485 amperes, is the energy component. Hence the wattless component is equal to

$$530^2 - 485^2 = 212 \text{ amperes.}$$

The four component voltages obtained as the products of

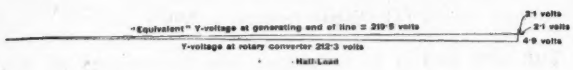


Fig. 11.

these component currents with the reactance of 0·01 ohm per phase and the resistance of 0·01 ohm per phase are—

$$485 \times 0{\cdot}01 = 4{\cdot}85$$
$$485 \times 0{\cdot}01 = 4{\cdot}85$$
$$212 \times 0{\cdot}01 = 2{\cdot}12$$
$$212 \times 0{\cdot}01 = 2{\cdot}12$$

and these are plotted in the diagram of fig. 11, which shows that the Y voltage of the rotary converter has fallen from 213·0 volts to 212·3 volts, so that the commutator voltage is

$$\frac{212{\cdot}3}{213{\cdot}0} \times 600 = 598 \text{ volts.}$$

The diagrams in figs. 12, 13 and 14 have been similarly derived for three-quarter load (when the current is in phase), and for 50 per cent. and 100 per cent. overloads (at which values the current leads).

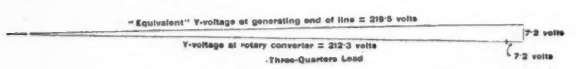

"Equivalent" Y-voltage at generating end of line = 219·5 volts
Y-voltage at rotary converter = 212·3 volts
Three-Quarters Load
7·2 volts
7·2 volts

Fig. 12.

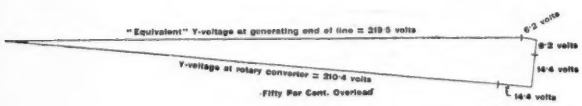

"Equivalent" Y-voltage at generating end of line = 219·5 volts
Y-voltage at rotary converter = 210·4 volts
Fifty Per Cent. Overload
9·2 volts
9·2 volts
14·4 volts
14·4 volts

Fig. 13.

These results are brought together in Table VI.

Table VI.

Total resistance per phase = 0·01 ohm.
Total reactance per phase = 0·01 ohm.
64 per cent. compounding at full load.
Adjustment for unity power factor at three-quarter load.
Equivalent voltage at the generating end of the line = 219·5 volts.

Per cent. of full load.	Y voltage.	Commutator voltage.
0	213·0	600
25 per cent.	—	—
50 „	212·3	598
75 „	212·3	598
100 „	—	—
125 „	—	—
150 „	210·4	592
175 „	—	—
200 „	209·5	589

In the same way as for 0·01 ohm reactance per phase, values were obtained for 0·02, 0·03 and 0·04 ohm reactance per phase, all with 0·01 ohm resistance per phase. Then

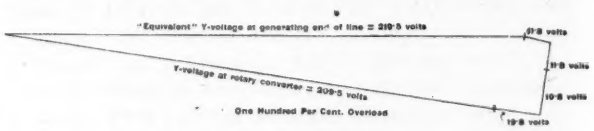

"Equivalent" Y-voltage at generating end of line = 219·5 volts
Y-voltage at rotary converter = 209·5 volts
One Hundred Per Cent. Overload
9·9 volts
9·9 volts
19·8 volts
19·8 volts

Fig. 14.

followed corresponding sets of calculations with *resistances* of 0·02, 0·03 and 0·04 ohm per phase. The results of these calculations are given in Table VII.

The results in Table VII. are plotted in the row of curves of fig. 17A, the whole group comprised in this row corresponding to an adjustment for unity power factor at three-quarter load, with 64 per cent. compounding at full load, the total full load excitation thus consisting of

6,000 shunt ampere-turns per pole
and 3,830 series ampere-turns per pole.

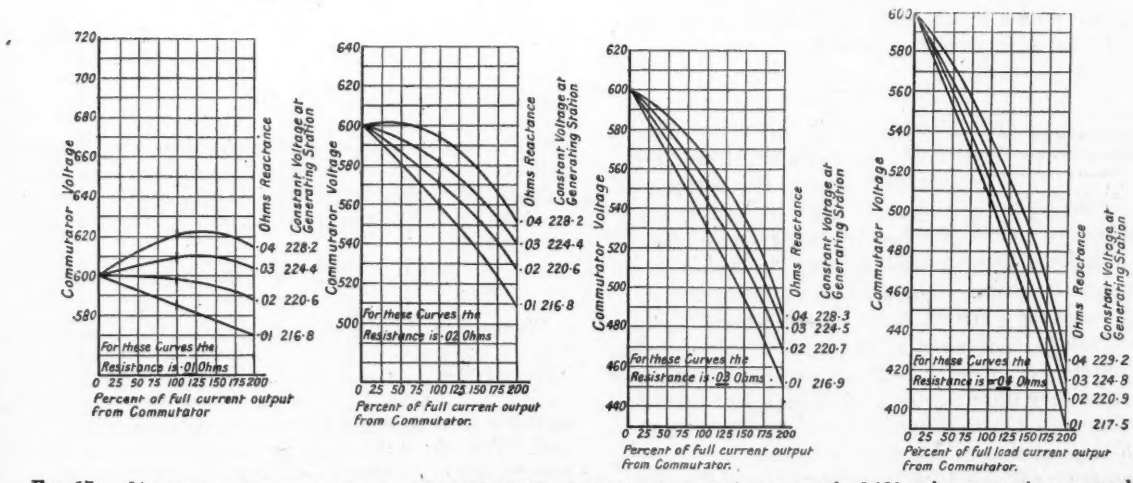


Fig. 17A.—64 per cent. Compounding. Full Load Excitation, 6,000 shunt ampere-turns per pole, 3,830 series ampere-turns per pole.

Table VII.—64 per cent. Compounding at Full Load. Adjustment for Unity Power Factor at ¾-Load.

Per-centage of full load.	Commutator voltage.																
	·01 / ·01	·01 / ·02	·01 / ·03	·01 / ·04	·02 / ·01	·02 / ·02	·02 / ·03	·02 / ·04	·03 / 01	·03 / ·02	·03 / ·03	·03 / 04	·04 / ·01	·04 / ·02	·04 / ·03	·04 / ·04	= ohms resistance / = ohms reactance
0	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	
25 %	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
50 %	598	610	620	632	583	596	609	620	572	579	597	609	560	573	577	590	
75 %	597·5	615	631	645	576	594	610	626	559	570	593	610	540	555	565	582	
100 %	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
125 %	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
150 %	592	621	650	676	547	578	605	628	507	531	565	586	465	493	510	534	
175 %	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
200 %	589	629	665	710	527	564	599	627	465	495	533	555	402	432	453	475	
Generated Voltage..	219·5	225·9	232·2	238·6	219·5	225·9	232·2	238·6	220·0	224·8	233·5	239·5	220·8	227·0	231·0	237·8	

The Effect of a Change in the Adjustment of the Compounding.

Suppose the field excitation is so rearranged that it shall, at no load, give 7,000 ampere-turns; at three-quarter load, 8,870 ampere-turns, and at full load 9,500 ampere-turns, there thus being 36 per cent. compounding at full load. This adjustment is indicated by the broken line *c d* in fig. 8, and corresponds to the values given in Table VIII. for the amperes input per phase at various outputs, the energy component, the wattless component, the efficiency and the power factor.

Table VIII.—Rotary Converter adjusted for Unity Power Factor at Three-quarter Load and 36 per cent. Compounding at Full Load.

Per cent. of full load amperes output from commutator.	Commercial efficiency of rotary converter.	Y-amperes input to rotary converter per phase.	Energy component of amperes input.	Wattless component of amperes input.	Power factor.	Field excitation in ampere-turns per spool.
0	0 %	380	25	380	·066	7,000
25 %	88·0 %	370	255	266	·680	7,620
50 %	94·3 %	500	485	123	·970	8,250
75 %	95·5 %	720	720	0	1·000	8,870
100 %	96·0 %	983	975	115	·991	9,500
125 %	95·5 %	1,215	1,190	244	·980	10,120
150 %	94·8 %	1,490	1,440	388	·967	10,750
175 %	93·5 %	1,775	1,700	510	·957	11,370
200 %	92·0 %	2,090	1,980	665	·946	12,000

The results in Table VIII. are plotted in fig. 15. A set of results have next been calculated for the performance of the rotary converter with this new adjustment, when operated under the same conditions of reactance and resistance as when adjusted for 64 per cent. compounding. The results are compiled in Table IX.

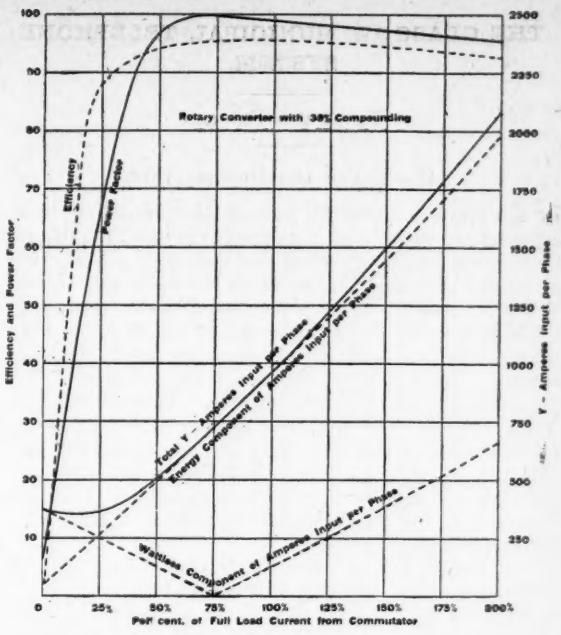

Rotary Converter with 36% Compounding
Efficiency
Power Factor
Total Y - Amperes Input per Phase
Energy Component of Amperes Input per Phase
Wattless Component of Amperes Input per Phase
Efficiency and Power Factor
Y - Amperes Input per Phase
Per cent. of Full Load Current from Commutator

Fig. 15.

The curves embodying the results of Table IX. are to be found in the row of curves in fig. 17B, entitled "36 per cent. compounding."

(*To be continued.*)

Worsley Tramways.—The Council hopes to be able to announce shortly an arrangement for the construction of tramways in the Walkden and Worsley districts, and the connection of the South Lancashire system with Eccles, at Worsley Road.

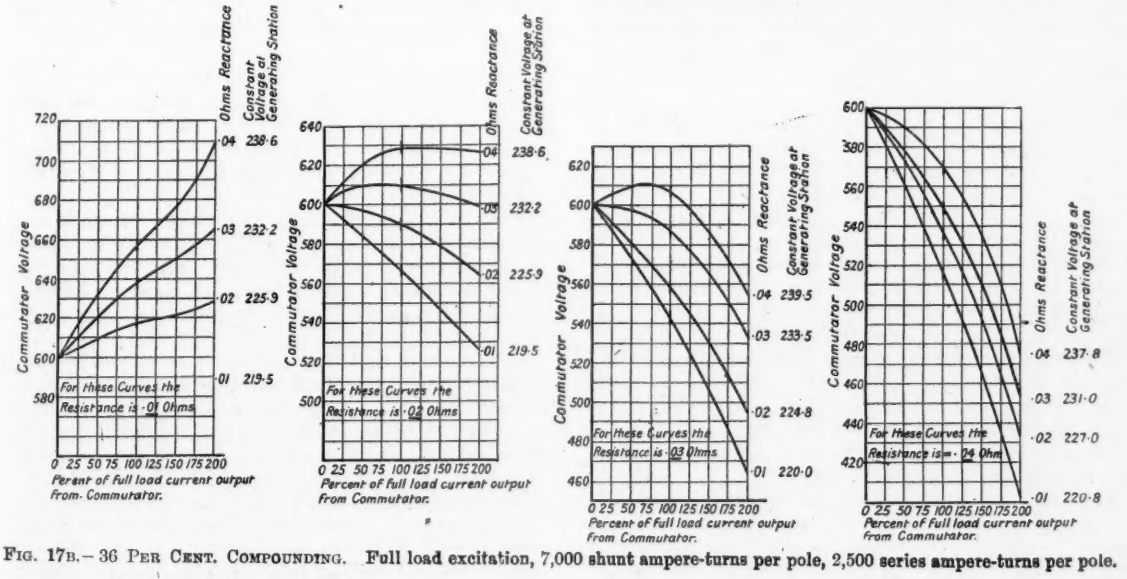

Commutator Voltage
Ohms Reactance
Constant Voltage at Generating Station
For these Curves the Resistance is ·01 Ohms
For these Curves the Resistance is ·02 Ohms
For these Curves the Resistance is ·03 Ohms
For these Curves the Resistance is ·04 Ohm
Percent of Full load current output from Commutator.

Fig. 17B.—36 Per Cent. Compounding. **Full load excitation, 7,000 shunt ampere-turns per pole, 2,500 series ampere-turns per pole.**

Table IX.—36 per cent. Compounding at Full Load. Adjustment for Unity Power Factor at ¾-Load.

Per-centa e of full load	Commutator voltage.																
	·01	·01	·01	·01	·02	·02	·02	·02	·03	·03	·03	·03	·04	·04	·04	·04	= ohms resistance
	·01	·02	·03	·04	·01	·02	·03	·04	·01	·02	·03	·04	·01	·02	·03	·04	= ohms reactance
0	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	
25 %	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
50 %	593	600	605	611	579	586	593	601	565	572	580	586	553	560	566	575	
75 %	589	599	607	617	570	578	587	598	550	560	566	577	520	539	549	557	
100 %	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
125 %	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
150 %	578	595	609	622	537	553	565	578	495	512	523	535	454	468	480	493	
175 %	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
200 %	570	587	603	615	509	528	540	551	451	469	480	487	392	406	416	423	
Generated voltage.	216·8	220·6	224·4	228·2	216·8	220·6	224·4	228·2	216·9	220·7	224·5	228·3	217·5	220·9	224·8	229·2	

THE GLASGOW MUNICIPAL TELEPHONE SYSTEM.

Facts and Figures.

II.—Plant and Depreciation.

In the previous article we showed that, according to the accounts and statistics of the department itself, the Glasgow Corporation telephone system had cost, at May 31st, 1903, at the very least, £58,897 more than was estimated, with due allowance made for spare plant, and £88,175 more than it would have cost if the estimate of March, 1900, on which the plant was constructed, had been borne out by the actual results. That estimate worked out at an average of £23 1s. per working line, including spare plant. The actual cost, also including spare plant, and after making a liberal allowance for extension instruments and private lines, has been £34 18s. per working line. These figures are sufficiently different from the figures for average capital cost that have been used in the Town Council discussions at Glasgow, to need some explanation.

The explanation is a very simple one. Since the plant has been working, and after it was found that the capital expenditure did not square with the estimates, the device adopted has been to quote the total number of *instruments* instead of the total number of lines. By that extremely simple expedient the apparent average capital cost per instrument has been shown to be somewhere near the estimated average capital cost per line. That being so, it was a naturally easy step of transition to drop the term "instrument" and use the term "line" or "subscriber" as synonymous. Thus, the Glasgow Corporation telephone department, by scraping everything together, extension stations, service instruments, sundry lines, and what not, shows a grand total of 9,122 instruments. In the Town Council these 9,000 instruments become 9,000 "subscribers," which they are not. But the technicalities of telephonic nomenclature are not understood by the general public, not always by chairmen of telephone committees, nor even by all technical journals, and "9,000 subscribers" becomes a current fiction.

This being so, it is easy to show that the average capital cost has not greatly exceeded that laid down in the estimates. Deduct the £59,096 for spare plant from the £270,938 of total capital, and you get £211,842, which, divided by 9,122, the number of instruments, gives an average of £23 4s. per instrument. This is only £4 3s. per instrument in excess of the estimate, amounting to a total of £37,856—a mere bagatelle to a rich municipality. But the estimate clearly did not contemplate "instruments"; it specifically provided for so many "subscribers' lines" and all municipal telephone estimates have been drawn in the same way. That lines and not instruments are what the estimates contemplate is clearly shown by the fact that extension instruments are never mentioned in municipal telephone estimates, and that the estimates of average revenue to be obtained do not recognise extension instruments.

We do not wish to labour the point, although it is evident that the distinction between lines and instruments is not generally understood. Otherwise the fallacious figures regarding the Glasgow system could never have gained currency and general acceptance. It is no doubt quite legitimate to advertise the total number of telephones of all kinds in a system, so as to impress the public with a sense of its magnitude. Every telephone connected to the exchange has its use, and it is only fair that its presence should be counted and made known. What is most distinctly not legitimate is to average together, in comparing actual capital cost with estimated capital cost, inside extension instruments, which cost only £4 each to establish, with complete subscribers' lines that cost over £30 each to establish. This is what has been done at Glasgow, and in this way the great excess of the actual capital cost over the estimated capital cost has so far escaped serious attention. We note that in the recent discussion at the Glasgow Town Council meeting the average capital cost per subscriber was not mentioned, but in the discussion on the last loan of £80,000 it was frequently referred to. This discussion took place as lately as January 8th of this year, and it is clear from the report of the proceedings that the worthy councillors one and all took the number of instruments then working to be the number of actual subscribers' lines. The average capital cost per instrument was then given as £21 8s., so even on the basis of instruments there has been a rise of £1 8s. per instrument in a very few months.

Having now made the question of capital cost clear, we pass to the important subject of depreciation. On this point we have received a letter from Mr. D. M. Stevenson, who rejoices in the neat title of "vice-Convener of Committee on Telephones" asking us to reproduce a letter addressed by him to the editor of *Engineering*, and published in the issue of that journal for September 18th. In that letter Mr. Stevenson answers certain criticisms of the Glasgow telephone accounts made by *Engineering*. No doubt *Engineering* is amply able to take care of itself in any discussion with Mr. Stevenson, and while we are much interested in Glasgow telephones, and have no doubt many of our readers are also, we have not the space available to reproduce the article in *Engineering* and Mr. Stevenson's letter. It would serve no purpose to reproduce the one without the other, but inasmuch as Mr. Stevenson seems to think his letter disposes of our criticisms of September 11th, we will abstract his chief points and then proceed to dispose of *them*.

Point 1 is that "Depreciation is amply provided for by a sinking fund of $3\frac{1}{3}$ per cent. per annum on the total expenditure, on the basis of the average life of the undertaking being 30 years." In support of this Mr. Stevenson quotes the Postmaster-General's report, in which it is stated that the estimated life of the London Post Office telephone plant averages 36 years, and he thinks that Glasgow has shown "excessive prudence" in choosing to take 30 years as its basis.

Point 2 is that "the bulk of our wires are formed into properly-insulated lead-covered cables, and these again are run in iron ducts underground. It is impossible to set any reasonable limit to the life of such material, and when against that is put the comparatively short life of instruments, &c., it will be seen that if the Corporation errs at all in taking an average of 30 years it errs on the side of safety."

Point 3 is that Mr. Stevenson thinks that if the State does acquire the Glasgow telephone system, the State will pay the Glasgow Corporation more than the plant is worth.

Point 4 is that "All the plant put in by the Glasgow Corporation Telephone Department meets the Post Office requirements."

Point 5 is that, although "new wires" mean increased expenditure, there is a sum of £59,096 "invested in works not yet earning revenue, or, in other words, in anticipation of future demands. Every new wire, therefore, for a long time to come, at least, will mean a proportionately higher net revenue."

It is evident that Mr. Stevenson has not yet become, in spite of his sonorous telephonic title, a competent judge of matters telephonic. This is by no means to his discredit, as no Town Councillor, in the evening of a lifetime spent in other callings, could reasonably be expected to master a complicated and extremely technical business by the simple process of attending weekly committee meetings for a period of a year or two. There is a fallacy, or an error of fact, in every one of Mr. Stevenson's points. In the first place, depreciation and sinking fund are not altogether the same thing, as Mr. Stevenson assumes. The Glasgow Corporation have already acknowledged that they are not the same thing by establishing a depreciation fund in addition to a sinking fund; the Postmaster-General recognises that they are not the same thing by providing for depreciation as well as for sinking fund. In telephone working there is greater need to provide for depreciation than in some other electrical undertakings, because of the perishable nature of a large proportion of the plant, and because of the rapid antiquation of plant due to the constant introduction of improvements in telephone apparatus and methods.

It is important to consider what is the nature of the plant which has an estimated average life of 36 years, and of that which Glasgow, with such excessive prudence, has taken at only 30 years. Any engineer who has followed the subject knows that the Post Office plant in London is a totally different thing from the Glasgow municipal plant. With the possible exception of a portion of the cable plant at

Glasgow, there is no comparison at all to be made between the two systems. In the London system not only is every inch of wire underground and properly laid in pipes, but the exchange equipment and sub-station apparatus are of the latest type of common battery working, giving the great advantage of automatic signalling in the operation of the service. In the Glasgow system, on the other hand, a good deal of the wire plant is overhead, a large proportion of the cable plant is armoured cable laid directly in the ground, and the exchange equipment and sub-station apparatus are on the antiquated call-wire system, which is in use nowhere else in the world on a large scale. The following table shows the capital cost of each part of the plant at Glasgow, and the proportion each part bears to the whole :—

Capital Cost, Glasgow Municipal Telephones.
As at May 31st, 1903.

Item.	Amount.	Percentage of total.
Underground construction ...	£147,293 13 9	54·32
Overhead construction... ...	38,300 4 7	14·14
Central office construction ...	33,377 4 11	12·32
Subscribers' stations	39,587 13 4	14·6
Public telephone offices ...	869 18 6	·32
Preliminary expenses, stores, furniture and fittings ...	11,509 15 4	4·3
Total	£270,938 10 5	100 00

From this little table it is clear that the Glasgow plant is on quite a different footing from that of the London system of the Postmaster-General, with which Mr. Stevenson so erroneously compares it. For one thing, 14·14 per cent. of the total capital is invested in overhead plant ; of this type of plant the Post Office London system has none. It is plant subject to rapid deterioration, and should be charged with a high rate of depreciation. The exchange and subscribers' station apparatus, including public telephones, accounts for 27·22 per cent. of the total capital. All of this apparatus was obsolete and out-of-date when it was put in, and this method of working was adopted in spite of the Postmaster-General's recommendation that the most modern system should be used. The 4·3 per cent. of the capital represented by "Preliminary Expenses" should properly have formed a first charge against revenue. Failing that, it should certainly be extinguished within the period of the license. The Post Office may be as simple as Simon, but it is not likely to be in the market as a purchaser of preliminary expenses. We have, then, a total of 45·68 per cent. of the capital invested in the Glasgow Corporation telephone system, on which the most elementary prudence would dictate a depreciation charge of at least 10 per cent. per annum. This would require no less than £12,376 yearly.

There remains the cable plant, forming the larger proportion of the capital cost, as it represents 54·32 per cent. of the total. In previous discussions the Glasgow Telephone Committee have fallen back on the cable plant as a portion of their assets which would be worth all it cost at any time. Mr. Stevenson says all the cable is laid in iron ducts ; but turning to the statistics we find the following :—

Mileage of armoured cable laid, 66 miles 1,622 yards.
„ „ cable drawn into pipes, 95 miles 1,314 yards.

So that it appears that of the total length of 162 miles of cable in the system, over 66 miles, or more than two-fifths, is not drawn into pipes at all, but consists of armoured cable laid in the ground. This class of work is not usually done in telephone systems, and is not likely to find favour with the Postmaster-General. The two-fifths of armoured cable probably represents about one-fifth of the total value of the underground construction account—say, £29,000. On this also depreciation at the rate of 10 per cent. ought to be allowed, bringing up the depreciation fund required to £15,276. On the portion of the cable plant which *is* laid in pipes, representing under 44 per cent. of the whole investment, a depreciation charge of 2½ per cent. on the conduits and 5 per cent. on the cables—say, an average of 4 per cent. on the whole, is admissible if the work has been thoroughly well done. This would amount to £4,731, bringing the total depreciation charge up to £20,007, an average of about 7·4 per cent. The sinking fund is at the rate of only 3⅓ per cent., so that the Glasgow Corporation Telephone Department is omitting about £11,000 from its charges against revenue, if depreciation is to be recognised in a safe way. In other words, even if the plant were not extended along its present lines, the Glasgow Corporation telephone account will have to face, at the end of the licence, a *lacuna* of over £100,000 ; and it is to the last degree improbable that the Post Office will consent to fill that deep hole up with the taxpayer's money.

So much for point 1 of Mr. Stevenson's argument. Point 2 has already been disposed of, as it has been shown that the cables are not all "run in iron ducts underground." Further, in view of the rapid progress in the art of telephone cable making it is not only possible but advisable "to set a reasonable limit to the life of such material."

As to point 3, Mr. Stevenson shows a greater degree of innocence on matters of buying and selling than we believed could exist North of the Tweed. The State is seldom given to excess of generosity towards sellers in any case, and in the case of the Glasgow telephone plant it might conceivably go in the opposite direction, and perhaps squeeze the Corporation as some Corporations have squeezed tramway companies and other private concerns. Moreover, Mr. Stevenson ignores the fact that the obsolete character of the Glasgow telephone plant is well known and has been frequently referred to ; it is probably not unknown to the Post Office.

Point 4 may be true to the letter, but not in the sense intended. The plant may meet the broad requirements laid down in the licence specification, which practically confines itself to specifying the use of metallic circuits and of signals that will work. But the Glasgow plant is as different from the Post Office London plant as chalk is from cheese, and it is little likely to meet the requirements of the Post Office when the Post Office comes to consider taking it over.

Point 5 means, if it means anything, that new wires for a long time to come will be brought into use without increase of capital expenditure. This is very unlikely. Spare plant must always exist, and can never be entirely utilised. If Mr. Stevenson is serious in this claim, viz., that "every new wire for a long time to come will mean a proportionately higher net revenue," he must mean that the Glasgow Corporation has ceased extending the telephone system, and is spending no more money in new construction. We doubt very much if this is the case. If it were the case it would be tantamount to a confession of failure, as the telephone system that stops building soon begins to decay. It is plain from Mr. Stevenson's fifth point that he has not yet grasped the vital question of spare plant. From the very nature of the business the spare capacity must always exist, and it is a difficult matter, in a growing telephone system, to hold the balance even and extend the plant in such a way as to prevent, on the one hand, the spare plant from becoming too great a burden, and on the other, to avoid the serious difficulties that arise from an insufficiency of spare capacity.

"THE CHIEF," FROM AN ASSISTANT'S POINT OF VIEW.

By "R-V."

In these days of severe competition, when the supply of assistant electrical engineers so greatly exceeds the demand, and when the salaries given for their services are so paltry, the necessity arises for the utmost good-feeling between them and their chiefs, in order that they may not become disheartened with their positions.

The greatest amount of tact and thoughtfulness is called for on the part of the chief engineer in his relations with his staff. He should endeavour as far as possible to take a personal interest in the work allotted to them in their several departments, but at the same time, if they are capable men, give them a free hand in the work over which they have charge. Where the assistant is young, and perhaps enthusiastic and energetic, he should be encouraged to talk over matters with his chief, and to come to him for friendly advice in any small difficulty that arises.

How often it is that a chief fails to realise the effect on his assistants of a few words of praise or commendation when they have taken some particular pains, or have worked extra hard on some urgent job.

Nothing is so disheartening to an assistant, particularly a young one, as to have no notice taken of him by his chief when he has worked hard, perhaps during many hours of the time that he might reasonably call his own, in order to carry out successfully some special job, or when he has saved his department a considerable amount of money by putting his brains to work and scheming to reduce expenditure on any particular piece of work.

It is the duty of a chief to encourage his assistants in every possible way to throw their whole energy into their jobs, and he should never hesitate to give a mead of praise where praise is due. But at the same time he should not fail to deal with them with a firm hand if they overstep the bounds, for by so doing he will earn their lasting respect.

Friction is often caused by the chief "talking over the heads" of his assistants to their men about some job on hand, instead of discussing the matter with the assistants, who are supposed to have entire charge of their gangs. An assistant perhaps tells his men to do a job in a certain way, afterwards comes the chief and tells the men to do it in another way. The assistant then comes back, and finding his men doing the job contrary to his instructions, promptly gets angry when he is met with the unanswerable, "The boss said we were to do it like this." No matter if the assistant had told the men the wrong way to do the job, the chief should have mentioned the matter to him first, except, of course, in a specially urgent case.

In the matter of pupils, too, there is often a considerable amount of ill-feeling. The chief takes the premium, and, as a rule, hands the pupil over to the care of his assistants each in their turn, and these are supposed to initiate him into all the mysteries of their several departments, to tell and explain to him everything that they have spent years in studying, and, in fact, have to add to their already underpaid jobs the often very onerous duties of technical instructor to a dullard! Is it a wonder, then, that the parents of pupils complain that they don't think that their sons seem to be learning much at their work? What an alteration of the case might be effected if it was the rule, instead of the exception, for the chief to divide, say, one-third of the premium amongst his assistants who have all the trouble and bother of looking after the pupil, and what a lot more practical knowledge the latter would acquire!

In municipal undertakings it is often the case that councillors or committeemen (and these, as a general rule, are totally ignorant of electrical matters) make it their business to spot out imaginary delinquencies in some department, and to report the same at their meetings. The chief is interrogated, and he, by the exercise of considerable tact, should be able to refute any imputation on the abilities of his staff. Even if the latter have acted indiscreetly, it is his duty to stick up for them as far as possible before his committee (unless the case be too glaring), and *afterwards* to deal with them in a suitable manner. If an assistant feels that his chief has not complete confidence in him, or that he can hesitate in trusting him implicitly, then by far the best thing for him to do is to seek fresh fields and pastures new.

On the other side of the question, an assistant should always bear in mind that the chief is his superior, and should not attempt in any way to disregard him or his position *as* chief, or do things too much on his own initiative. In important and vital matters concerning his department he should first and foremost go to his chief to consult, and if he has suggestions to offer, listen with patience to the more matured wisdom of his superior, even if the latter is an *inferior* superior.

But, in order to do this, he must feel that his chief *is* a man whose experience and judgment are such as to justify his deference, that he knows perfectly what he is talking about, and is capable of giving advice. If there is the least suspicion on the part of the assistant that his chief has had no experience in the matter under discussion, and cannot, therefore, grasp the particular difficulties about which his advice is asked, then he naturally loses all respect for him.

In conclusion, the writer is perfectly aware that he has made out a very one-sided case, but his apology must be that he happens at present to *be* an assistant, and such being the case, he awaits someone better qualified than himself to take up a brief for the other side.

CORRESPONDENCE.

L.C.C. Engines.

May I be permitted to in turn criticise your reply to "W. H. B.'s" letter in your last issue.

First as to the balancing of these engines; you say that it is a "fact that reciprocating parts cannot be balanced by revolving weights." Now while this is true for engines in which the reciprocating parts all move in one plane on the same side of the crankshaft, it is possible to obtain (as "W. H. B." states) almost perfect balance in a vertical-horizontal engine of the type proposed.

In the ordinary vertical engine, if a balance weight be fitted opposite the crank of such mass, referred to the crank-pin circle radius, as is equal to the mass of the revolving parts, plus the mass of reciprocating parts, balance as regards the primary forces in the vertical plane will be obtained; there will result, however, an out-of-balance in the horizontal plane equal to the effect of the reciprocating masses. The obvious remedy for this would be to cause a mass of equal amount to the vertically reciprocating parts to be reciprocated by the crank in a horizontal plane. Utilise this mass by making it the piston, &c., of a horizontal engine working on the same crank-pin, and you get the L.C.C. design. Forces of the second and higher orders produced by the finite length of the connecting rod will not, of course, be balanced, but neither are they in the Yarrow-Schlick-Tweedy system.

The moments of these primary forces could also be balanced exactly by adopting double-webbed cranks, and splitting the crank-pin end of either the vertical or the horizontal connecting-rod, so that the centre lines of the H.P. and L.P. engines should be in one plane.

With the design adopted by the L.C.C.'s engineer this perfection is not attained; but the difference is unimportant, and is far outweighed by the advantage of greater simplicity.

With regard to the stresses on the crank-pins, since the pins should be made of large diameter to obtain the necessary bearing area, the strains will be inappreciable, certainly not sufficient to spoil the bedding of the crank-pin bearings.

The inclination of the H.P. engines due to sagging of the crankshaft is certainly an objection to which all vertical cross-compound engines are open, but the angle can be calculated very closely; and, as "W. H. B." points out, mill engine builders find no insuperable difficulty in this problem. I fail to see that it is any more difficult because an alternator-rotor replaces a rope wheel. The L.C.C. design does not complicate the question, since if the bored type of cross-head guide be adopted, the L.P. connecting-rod, &c., will adapt itself to the skew of the crank-pin.

In conclusion, I would say that although I am far from deprecating advance in engineering, and although I believe heartily in the future of the steam turbine and gas engine, yet the present types have undoubted faults, and until these are substantially remedied, an engineer responsible for the design of a large station does well to specify machinery of a type whose success is assured by past results. The failure of the machinery of a station of 12,000 KW. output is a large risk.

H. J. A.

[Our correspondent is perfectly correct, and we must apologise for the error; the type of engine in question certainly can be well balanced. We had in mind at the time of writing "W. H. B.'s" reference to an angle of $112\frac{1}{2}^{\circ}$, and overlooked the peculiar features of the question.

We recognised in the first instance that considerations of prudence had doubtless influenced the choice of engine, but our suggestion was that the type of engine chosen had little to recommend it in this respect. As for the "large risk"—

British engineers are perhaps somewhat apt to suffer from excess of caution, and they will never lack the warnings of those whose interest it is to maintain the *status quo*.—Eds. Elec. Rev.]

Dry Cells: Patent Exploitation Co.'s Litigation.

Will any of your readers who are interested in this matter, either as having paid an amount for royalties and suggested damages, or having resented such application, forward their names and addresses to us, c/o the Electrical Review, as we wish to convene a trade meeting on the subject.

Correspondents.

October 12*th*, 1903.

Wanted: An Ideal Electric Glow Lamp.

Recently a correspondent writing in your columns inquired, not perhaps in the precise terms of the question as I have stated it, for a lamp possessing advantages over the ordinary types now in use. The communication was, as far as I can recollect (I have not the particular issue before me), an appeal to lamp manufacturers in the hope that something might be forthcoming which would have an interest alike for the engineer and the user.

What, with your permission, I am about to say is not, let me point out, the result of that appeal, for the question of marketing the particular lamp which I shall presently describe had been the subject of some negotiation. Singularly enough, though, the want supplied is synchronal with the request for an improved lamp. I deferred, therefore, for obvious reasons, writing you earlier; but I am now at liberty to state that my firm—Mackey's Electric Lamp Co.—are placing on the market an entirely new lamp possessing sufficient novelty, I think, to interest your correspondent as well as the host of others engaged in electric lighting.

It is, I repeat, an entirely new lamp. That is saying a good deal, perhaps; and as so much has been said regarding glow lamps, the reader may justly be inclined to take the statement with a pinch of salt.

Well, we'll see; let me briefly describe it. In possibly nine cases out of ten the light from a glow lamp is required concentrated in the axial direction, and for this reason various kinds of reflecting media have been used to attain this hitherto. A concentrated light, then, has been an object which up to the present it has been the desire of all incandescent electric lampmakers to attain, but generally found impossible to achieve.

The new lamp may be described as having the filament coiled so as to turn back upon itself, the whole of the light-giving element in the lamp being thus constructed to lie in a compact cylindrical surface. Thus the maximum light from this lamp is thrown downwards or in, what is without doubt, the most useful direction. No other incandescent electric lamp on the market does this.

The manufacturers, I may be allowed to state for your information, propose to make, in the first instance, a lamp constructed according to the "Farrall" patent, giving about 10 c.p. in the horizontal direction, the same lamp, measured axially, giving about 18 c.p. Thus, measured axially, the consumption will be about 2 to 2¼ watts per candle.

Now the reader is, no doubt, aware that the ordinary 16-c.p. lamp is nominally 16 c.p. measured in the horizontal direction, but, measured axially (the light thrown downwards) it only gives about 8 or 9 c.p., so that (here the real advantage to the user comes in) for the same current consumption of an ordinary 10-c.p. glow lamp, the new lamp gives 75 per cent. more light than the user is getting from an ordinary 16-c.p. lamp, in the axial or most useful direction. The lamp, in my opinion, is without question an ideal lamp for car and railway train lighting, libraries, reading rooms, shop windows (where frequently one sees the light on the ceiling and not reflected on the goods), restaurants, offices, the billiard table (I must particularise this) and other miscellaneous purposes of illumination where concentration of light in the axial direction is desired.

I think I have said sufficient to indicate the advantage obtained by the use of such a lamp. It will, I feel sure, have an interest for your querist, as well as others who may be on the look-out for an ideal lamp. Considerations of space have made it necessary to touch upon the merits of the thing very briefly. Messrs. Mackeys will be pleased to supply fuller particulars.

W. Young.

London, *October* 10*th*, 1903.

[A full discussion of the advantages of lamps with filaments designed to concentrate the light in the axial direction will be found on pp. 183 and 301 of the Electrical Review, February 1st and 15th, 1901. None of the lamps there described, however, gave results comparable with those claimed by our correspondent. We have one of these lamps in our possession, and hope to publish the result of a test upon it shortly.—Eds. Elec. Rev.]

Design of Ballistic Galvanometers.

I have to thank you for pointing out an error in the wording of my paper on "The Consideration of Some Points in the Working and Design of Ballistic Galvanometers," in which I have used the word "low" in place of the word "long."

To avoid further confusion on the subject, I should wish it to be understood that by "bringing down the period of a galvanometer," I mean "making the periodic time longer."

The error probably arose from confusing the terms "frequency" and "period"; a "low frequency" galvanometer having a "high period."

This error, of course, should not have been made, but it passed unnoticed in the reading of the paper, and I am indebted to you for pointing it out.

P. H. Powell, B.Sc.

University College, Liverpool.
October 12*th*, 1903.

[A correspondent asks for the address of a firm who make a speciality of electrical appliances for maturing wine, and for particulars.—Eds. Elec. Rev.]

THE INEFFICIENCY OF FREE LIBRARIES

By E. KILBURN SCOTT, M.I.E.E., A.M.I.C.E.

It is very generally acknowledged that under the present system, from the point of view of the scientist and engineer, free public libraries are not run on satisfactory lines. Novels, illustrated periodicals and literature of the *Tit-Bits* order form the bulk of the books in a library, and consequently the time of the librarians and his assistants is mainly occupied in catering for the frivolous class of reader.

If it stopped there, it might not be so bad, but as a matter of fact, in some provincial libraries the serious reader is actually discouraged. Suppose a reader, for example, wishes to consult back numbers of the Electrical Review. He gives in a ticket for several volumes, and after a good deal of waiting a boy staggers in with the books. After looking through these another ticket must be issued and the boy has again to be porter. It is no wonder, therefore, that he and his fellows discourage such a reader as much as they can.

The proper system clearly is the one adopted at the Patent Office Library, where the reader has free access to the book-shelves. For steady reading at one book the ticket system does well enough, but when a busy man has to look up a subject and must search for information here and there through many books and technical journals, the only way is to allow free access to the shelves.

To show how stupidly the libraries can be managed, the writer knows of a case where a valuable chemical reference-book was kept in one school for nearly a year by a system of transferring it between the teachers and elder scholars. Yet the librarian considered one copy was enough. In another case a library was singularly deficient in books on engineering, and one of the readers took the trouble to write out a list of the more important works. Instead of obtaining them at once, the Library Committee purchased them at the

rate of about one a month, and the requisitioner had been abroad nearly a year before his list was exhausted, and yet engineering was the most important trade in that particular town.

It has always been a puzzle to the writer why such go-ahead communities as the West Riding, the North East Coast, South Lancashire, and the Bristol, Glasgow, Birmingham districts, &c., have not before now agitated for proper technical and scientific libraries to be established in their midst on the lines of the London Patent Office Library. For instance, at Leeds all the scientific and technical books, the patent specifications, &c., should be placed in a separate building in charge of a technical man as librarian, and with a proper staff of intelligent assistants who could attend to visitors, as is done in the Chancery Lane Library. The additional expense incurred would soon bring its return by reacting favourably on the industries of the district.

Nothing helps a community so much as cultivating the brains of its individuals. The results of having good schools in a place are evident to everyone, and it would be the same if engineers, inventors, and scientifically minded people were properly catered for. At present, one of the incentives to a young man going to London is that he knows there are greater facilities in the way of attending meetings of scientific societies and better libraries, and other similar advantages. The first is being, to some extent, met by branch societies, such as those of the Electrical Engineers for example, and as for the second, engineers and scientific men should not rest until there are at least a dozen technical libraries as good as the one in Chancery Lane, and run on similar lines, scattered about the country.

There should be plenty of assistants who would be pleased to spend a year or two in such a technical reference library in between leaving school and taking up some work in the engineering or other technical industry. In these days of hurry scurry it is a great thing to be able to look up any particular subject quickly or to be able to make a patent search for oneself.

FIRST AIDS AND APPLIANCES.*

By J. D. M'GOWAN, M.D.

(*Concluded from page 576.*)

Transportation of Wounded.

The four-handed seat is made by two persons clasping each other's wrists. Doubtless many of you have done this in your boyhood days at school.

After the hands are clasped together, the bearers stoop down behind the patient, who sits on the hands, and places one arm around the neck of each bearer.

The two-handed seat is made by two bearers clasping their hands and placing their free hands on each other's shoulders. A bearer stands on each side of the patient and passes one arm under his knees and clasps the hand of the other bearer; the bearers then pass their arms around the back of the patient and grasp each other's shoulders.

The "pick-a-back" method may also be sometimes used. A temporary stretcher may be made by turning the sleeves of a coat inside out; two stout poles are then passed through them and the coat is buttoned. The patient sits on this and rests against the back of the first bearer. To make a longer stretcher, treat two coats in the same way.

Two sacks may be taken; a hole is made in each corner of the bottom, and two poles are passed through the sack and out of the holes.

A broad board or shutter may be used as a stretcher; if used, some hay, straw or clothing should be placed on it, and then a piece of stout cloth or sacking; the sacking is useful in taking the patient off the stretcher. Always test the stretcher before using.

Never allow stretchers to be carried on the bearers' shoulders.

Always carry patient's feet foremost, except when going up hill.

The "first-aid package," or "accident case," contains many things that are invaluable to the layman in applying relief to the injured; there are also some articles contained therein which none but a surgeon should be permitted to touch, such as needles, sutures, &c.

If, however, the surgeon, hastily summoned, should have omitted to bring with him all the requisites for cleansing, suturing and dressing a wound, it would be very gratifying to him to find everything ready for him in such a convenient, compact form.

One of the Chicago Edison emergency boxes, the product of Mr. W. L. Abbott's ingenious brain, is carried on each wagon.

It contains a box of Edison ointment, of whose healing properties we are justly proud, a gauze bandage, a first-aid package, a hypodermic syringe, and a solution containing one-twentieth of a grain of strychnine to each barrel of syringe. The strychnine is to be used to inject under the skin of a man who receives a shock from the high-tension wires. If a doctor is near by, it is well to have the solution ready for him; in the absence of a doctor the foreman is instructed how to use the syringe.

Shock.

Shock is common after serious accident, injury, burn, or from the electric current.

The symptoms or signs of shock are cool, clammy skin, vomiting and retching, weak, rapid pulse, sighing or irregular breathing, half-opened eyelids, dilate pupils, dullness of intellect and sometimes insensibility.

Place the patient in a warm, quiet place; after dressing wounds, wrap him in warm material and apply heat to the whole body, using hot-water bottles, water bags, hot bricks, blankets, flannels wrung out of hot water (no heat to head), hot drinks (coffee best), spirits of ammonia diluted with water, or small amount of whiskey.

Electric Shocks.—Susceptibility to shock depends upon the individual; women and children being less resistant than men. Diseases of heart and kidneys predispose to accident from electric shock. Do not lower the head of a person who has received electric shock. Artificial respiration should be kept up for hours. Massage of abdomen and left side over the heart. Heat the body as above.

Remove patient to a room in some adjacent house; remove most of his clothing; apply hot water bottles to body and limbs, wrap feet in hot wet cloths. Apply artificial respiration as explained below. Do not get discouraged if patient does not show signs of life; keep up the work for several hours. Men have been brought back to life after 10 hours of hard work, so work on patiently and constantly, and you may bring back a fellow workman who is apparently dead.

Artificial respiration is produced as follows, whenever it is required:—Face upwards; the hard roll of clothing beneath thorax, with shoulders slightly declining over it; head and neck bent back to the utmost. Hands on top of head (one twist of handkerchief around the crossed wrists will keep them there); rip or strip clothing from waist and neck; kneel astride the patient's hips; place your hands upon his chest, so that the ball of each thumb and little finger rests upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the xiphoid cartilage, the fingers fitting into the corresponding intercostal spaces; fix your elbows firmly, making them one with your sides and hips, then—

Pressing upwards and inwards towards towards the diaphragm, use your knees as a pivot, and throw your weight slowly forward two or three seconds until your face almost touches that of the patient, ending with a sharp push which helps to jerk you back to your erect kneeling position. Rest three seconds; then repeat this bellows-blowing movement as before, continuing it at the rate of seven to ten times a minute, taking the utmost care on the occurrence of a natural gasp, gently to aid and deepen it into a longer breath, until respiration becomes natural. When practical, have the tongue held firmly out of one corner of the mouth with thumb and finger armed with dry cotton rag. Avoid impatient vertical pushes; the force must be upward and inward, increased gradually from zero to the maximum as the age, sex, &c., may indicate. Abandon no case as hopeless within an hour's useless effort.

The following methods may be employed:—(1) Lay the patient on his back, with the shoulders elevated, draw the tongue forcibly forward, grasp the arms at the elbow and carry them upwards firmly upwards until they nearly meet above his head, then lower them to the side, and make firm compression upon the lower part of the breast bone; repeat this process 12 to 14 times in the minute. Or (2) turn the body gently and completely, on the side and a little beyond, and then on the face, alternately; repeating these measures deliberately, efficiently and perseveringly, 15 times in a minute.

* Presented before the National Electric Light Association at its Twenty-Sixth Convention, held at Chicago, Ill., May 26th—28th, 1903.

New Zealand and Duty on Imported Tramway Machinery.—*Australasian Hardware and Machinery* says that the duty on electric tramway machinery was discussed by the New Zealand Parliament on July 22nd. Petitions had been received from the municipal authorities in Christchurch, Dunedin and Wellington, praying that no duty should be imposed on electrical machinery imported for the construction of municipal tramways. The Public Petitions Committee, to whom the matter was referred, supported the petition on the ground that the proposed tramways were for the public benefit. In support of the request, the members for the cities concerned urged that the services contemplated were public services, and that the material could not satisfactorily be made in the colony. The Premier, the Right Hon. R. J. Seddon, resisted the suggestion on the ground that it would form a bad precedent if granted. Every Road and Harbour Board throughout the colony would be justified in making a similar claim in respect of the materials they used. The matter was discussed at some length, the Government putting forward speakers until it was "talked out."

DEVICES AND FITTINGS FOR THE CURRENT ELECTRIC LIGHTING SEASON.

(*Continued from page 578.*)

The London Electrical Fittings Co., Ltd., of Roberts Works, Hampstead Road, N.W., have lately patented an improved form of tilting counter-weight pendant, the "Lefco," which is shown in fig. 1. The improvement lies in the application of one weight instead of three or more, which has been the method previously adopted. The spherical weight gives it an extremely neat appearance, the shade remaining in any desired position at the lightest touch of the hand. This firm, who deal solely with the trade, have, from their commencement, struck out in quite a distinct line of their own, their designs in many cases being charming and original,

Fig. 2.

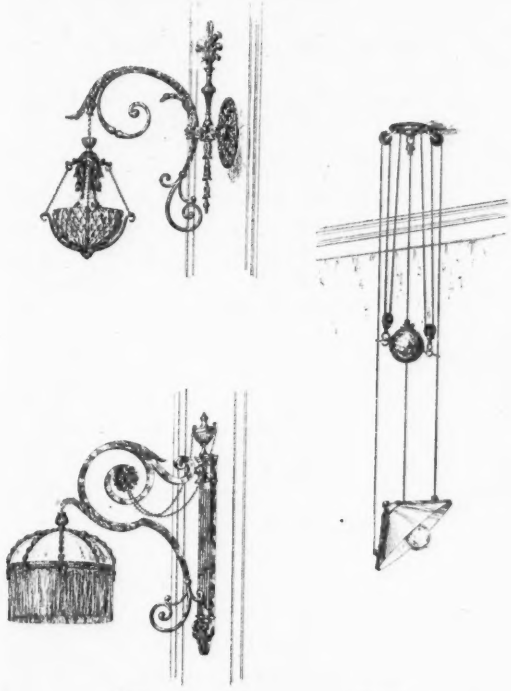


Fig. 3. Fig. 1.

and their finish of very high standard. The firm have lately been getting out a number of designs embodying the "Adam" style of ornament, some of these in the bracket form being illustrated above. Fig. 2 is very original, and has a most dainty effect when lit; the same remarks apply to fig. 3. An example of their

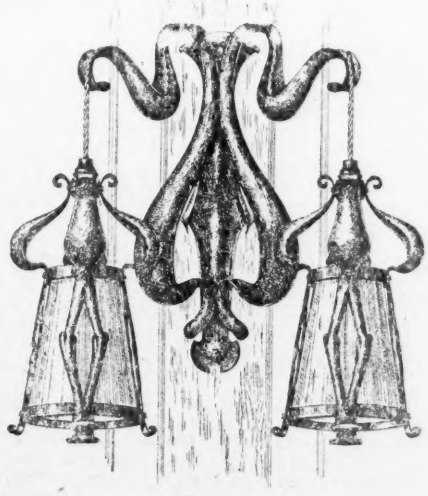


Fig. 4.

oxidised silver hand hammered work is shown in fig. 4, which is typical of the firm's own style in their simplicity of form combined with light effect, and they keep a stock always ready in the rough, which is finished in the various colourings required from time to time. Fig. 5 is also a very effective double bracket. It may be noted here that the two directors of this concern are both electrical engineers of considerable experience, and make a point of their fittings being electrically, as well as mechanically,

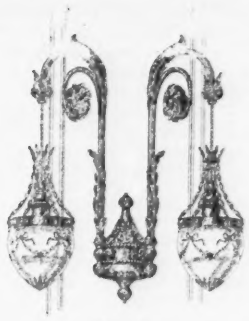


Fig. 5.

sound, and having them wired and tested across a 220-volt circuit before leaving their premises; needless to say, this saves endless trouble and expense to the contractor, who so often finds that trouble occurs on the completion of a job which is traced to careless wiring in the fittings. An advanced list of fittings has lately been issued by the firm, got up in a very handy form, printed on art paper from

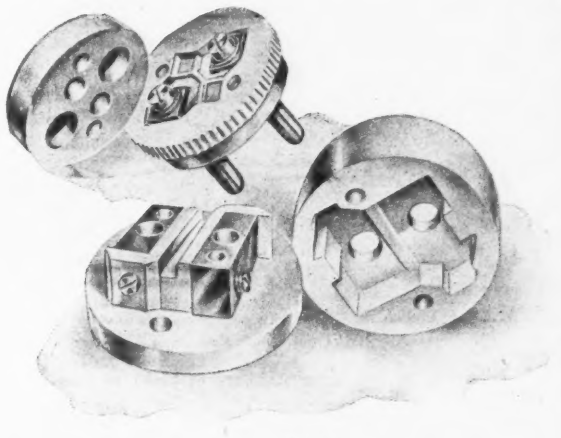
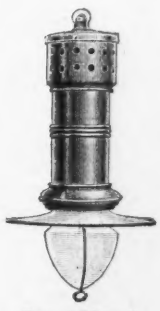


Fig. 6.

pen-and-ink drawings which have been carefully prepared. The complete list, showing some 80 illustrations, will be issued shortly. The L.E.F. Co. also do a large business in manufacturing and supplying accessories for lighting and traction work. A new high voltage wall plug styled "The Ajax," on account of its repute for defying short-circuits, is shown in fig. 6, the illustrations clearly defining its construction, the chief features of which are—firstly, the solid cover which can be thrown about at will without breaking; secondly, the excellent contact block; and, lastly, the absence of threads in the china.

The "Mite" Lamp.

Messrs. Arc Lamps, Ltd., of 62, Old Broad Street, E.C., are putting upon the market a new lamp known as the "Mite," which is intended to take the place of incandescent and semi-incandescent lighting. The lamp is 16 in. long, and will work with 1½ to 2 amperes, and burns for about 40 hours with one trimming. It will run either singly on 100 to 110 volts, or two in series on 200 to 250 volts. The lamp is simple, and is claimed to burn very steadily with a clear soft white light. It is most suitable for side street lighting, and for the lighting of railway waiting rooms, restaurants, libraries, offices, yards, alleys, halls and gardens. It is made on the same principle as the company's well known W. J. Davy lamps. This lamp has not been put on the market hurriedly, but, we understand, has been carefully and severely tested and simplified during a period covering over 12 months. Already the demand for the "Mite" lamp has been very considerable, and there has been some difficulty in keeping pace with orders.



The "Mite."

Gilbert Arc Lamps.

The Gilbert Arc Lamp Co., Ltd., of Chingford, whose lamps are being used for public lighting purposes in more than 40 towns, and whose chief features are already pretty familiar to readers of the Electrical Review, have lately brought out an August, 1903,

edition of their catalogue. Prices, and full descriptive notes of different patterns of lamps (open and enclosed), transformers, carbons, lamp-post gear, raising and lowering gear, also the Gilbert automatic switch, appear.

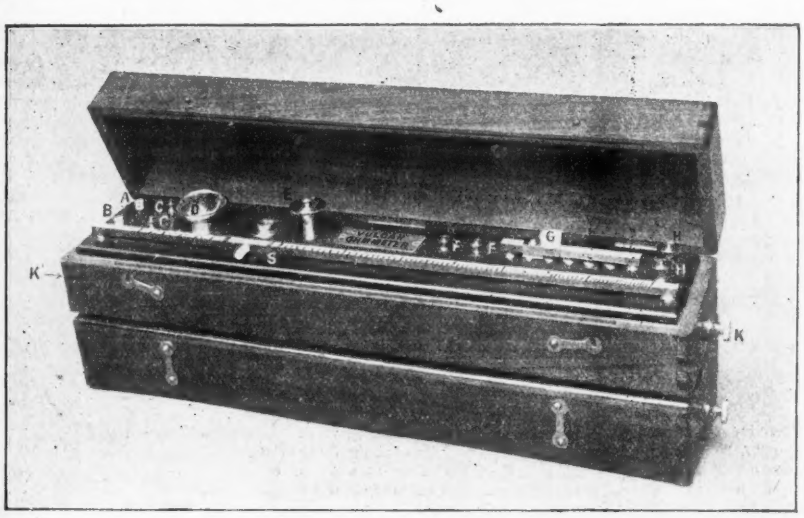
Braulik's Electric Lighting.

Mr. G. Braulik has on view at his Upper Thames Street showroom, the miniature arc lamp, which is especially suited to shop and house lighting; it is designed to meet the demand which has been a characteristic of recent electric lighting seasons, for a small lamp to take currents of from 1 to 2 amperes. It is an enclosed lamp with simple regulating mechanism consisting chiefly of a solenoid on the magnet of which a special frog terminal is provided for holding the top carbon. For single burning on a 110 to 120 volts circuit, it is constructed as a main current lamp, in which case the solenoid is made with a special winding, obviating the necessity for a line resistance when switching direct to the circuit. For series burning in pairs on 220 volts, differential mechanism is adopted, this necessitating putting a steadying resistance into the circuit. The Schumann electric motor and the "Eclipse" electricity meter are also being placed before the trade, together with a variety of other electric apparatus and fittings for lighting work. Mr. Braulik will shortly be placing a new prepayment meter on the market.

The Vulcan Ohmmeter.

Messrs. Geipel & Lange are introducing a new ohmmeter which is adapted specially for wiring contractors and others in similar positions. It is an adaptation of the Wheatstone bridge, but without plugs and their attendant disadvantages. In the illustration it will be seen that the set takes the form of a wooden case, having a graduated cursor bar S running along the front, with a five-stop switch G behind it. The operation of the ohmmeter is as follows:—

The ends connecting the resistance to be measured are joined to the two terminals H H, and the two cursors S and G are adjusted until, on pressing the buttons A and B, the galvanometer needle under the



The Vulcan Ohmmeter.

lens D does not deflect. The resistance is then read off directly from the graduations on which the cursors S and G finally remain.

The instrument has a range between ·1 ohm and 20,000,000 ohms. It is suitable, therefore, for use either as an ordinary workshop instrument, or particularly for making insulation measurements. It is accurate within ordinary commercial limits, but no attempt has been made to secure extreme accuracy, as the conditions under which it is to be used do not demand such refinement.

The whole equipment with cells, connecting the maximum voltage of 20, is contained in a case 19 in. × 5½ in. × 4 in., whilst the weight is 11 lbs.

A 12-c.p. B.T.H. Lamp.

A novelty is now being introduced by the British Thomson-Houston Co. in the shape of a 12-c.p. B.T.H.-Edison incandescent lamp. At present there are only 8 and 16-c.p. lamps on the market, and the British Thomson-Houston Co., recognising that a want existed for a lamp of a candle-power between these two, are now producing at their works at Rugby, one of 12 c.p., which has the same appearance as the standard 16-c.p. B.T.H.-Edison incandescent lamps. The efficiency is 50 watts. The B.T.H. lamps are supplied for operation on circuits whose voltages are from 200—250 volts. The special point in regard to this new Rugby lamp is the cap, which is absolutely waterproof, and is cemented on with a non-hygroscopic cement. It has a high spherical candle-power, and a good distribution of light in a useful direction.

Messrs. R. S. Keep & Co., of Anchor Works, Adams Street, Birmingham, have a number of novelties for the coming season such as pendants, electroliers, and the larger class of brackets and decorative work. They are extending in these directions, but have closed down the lampholder and tumbler switch shops.

The Ipswich Disconnecting Box.

The accompanying figure (fig. 1) shows a four-way mains disconnecting box, such as Messrs. Johnson & Phillips have lately supplied in connection with the Ipswich municipal electricity supply system. It is intended for four sets of three single distributor

Fig. 1.—Ipswich Disconnecting Box.

cables, and is of sufficient depth to permit a pathway frame and cover to be bolted directly on to the top of it. A packing piece between the box and the frame and cover allows for adjustment to the level of the pathway. An internal bell cover keeps the interior perfectly dry and water-tight and is easy of removal. All the fittings are mounted on a marble slab and are on the bus-bar

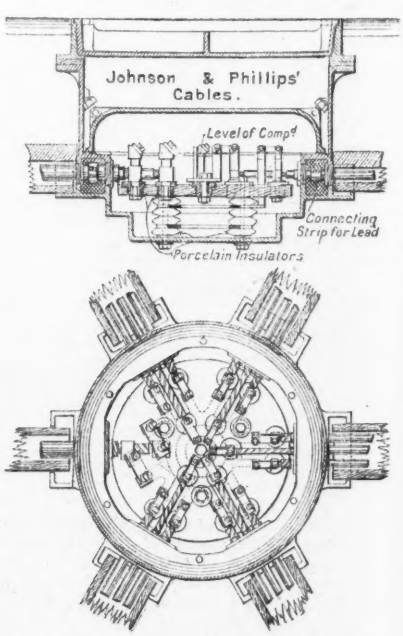


Fig. 2.—Six-way Feeder Box for Ipswich

principle, so that any cable may be disconnected by means of its link without disturbing the rest. The fittings are arranged for the neutral lead to be between the positive and negative leads, and by an alteration of the fittings the positive or negative leads may be on the right or left hand as desired; also any cable may be disconnected from the rest of the fittings for testing purposes, so that the insulation of the box is not included in the test. Fig. 2 shows a six-way feeder box which is somewhat similar to fig. 1. The internal cover is fixed down with bolts, and the fittings are of the inclined link type, enabling them to be easily removed without fear of short-circuit.

Messrs. Vandam's Lighting Accessories.

In the accompanying figures (see facing page) we show three of Messrs. A. Vandam & Co.'s lately introduced accessories for electric lighting service. Fig. 1 represents a double-pole tumbler switch. A porcelain cover encloses the whole of the interior action. The switch is constructed with a well insulated handle bar, connecting the action of both switches, and a T-shaped handle at the side, which, when turned to the right or to the left, connects or disconnects the circuit. The two poles are well separated by a high porcelain bridge. The breaks between the contacts and the levers are very large. The switch is suitable for circuits up to 250 volts.

Fig. 2 shows a cut-out with automatic replacement fuse, designed for temporary short-circuits, such as are caused by short-circuiting of lamps and other minor accidents, in order to prevent the whole place below being thrown into darkness. It contains two single-pole fuses, one of which is held in place by a tension on one side, and when fused will immediately be replaced by the second fuse, through a switch action.

From fig. 3 the construction of the firm's two-pin 25-ampere wall plug with locking action will be understood. For high amperage

circuits it should be made impossible to withdraw the plug from the base when the current is connected, and to help in this direction the firm have invented an arrangement by which the plug can only

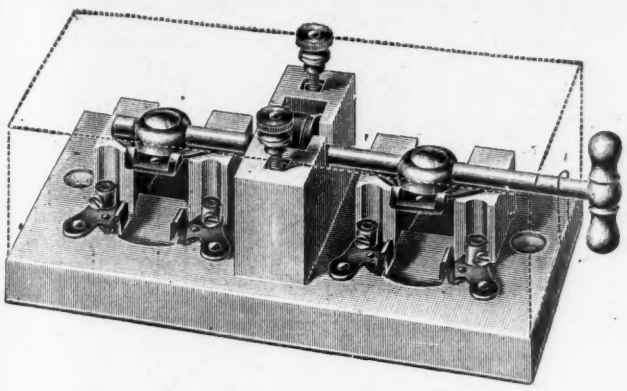


Fig. 1.—Vandam's Double-pole Tumbler Switch.

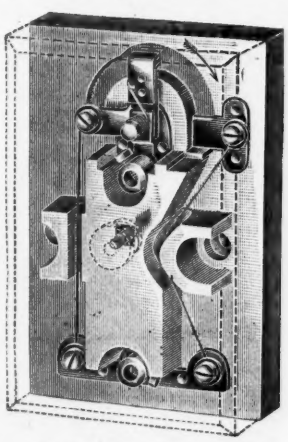


Fig. 2.—Cut out with Replacement Fuse.

be withdrawn from the base when the switch action is off—that is to say, when the current is disconnected. The firm's new patent high-voltage tumbler switch and combined two-pin wall plug forms a unique arrangement for an ordinary tumbler switch, which can be used at the same time as a wall-plug connection. It is provided with an ebonite plug top, which can be inserted on the side of the porcelain base.

Other specialities of Messrs. Vandam's include a new high voltage concentric wall plug with switch action. The switch action is arranged for the purpose of obviating the necessity of withdrawing the plug from the base, but the light can be put out by simply shifting the lever of the switch action to the left; and if the light is to be put on, the lever of the switch action has simply to be shifted to the right.

Another recent device is a registered dust-proof cover for obviating the trouble which frequently arises with wall and floor plugs through dust accumulating in the holes where the pins are inserted. When the plug is taken out, the holes through which the conducting pins are inserted are covered by a brass plate, which closes down, and is held securely by a spring. A new multiple plug has been designed enabling five different circuits to be branched off from the same wall plug, each being capable of carrying 5 amperes, the base terminals carrying 25 amperes.

B.T.H. Concentric Light Diffuser.

An objection to arc lamps for interior shop lighting, which applies more particularly to the open type, but also to some extent to the enclosed type, is that there is a tendency to concentrate the light in a circle beneath the lamp, and a perfectly even distribution of light is difficult to obtain.

In order to improve the distribution of light with the enclosed arc lamp, the British Thomson-Houston Co., Ltd., has introduced the Concentric Light Diffuser, which is shown in the illustration below. This apparatus, which is of an exceptionally simple character, prevents sharp contrasts and diffuses the light equally in all directions; the effect of the wandering of the arc has thereby been reduced to a considerable degree, so that the light at any point is, to a great extent, independent of the position of the arc with respect to the carbon ends.

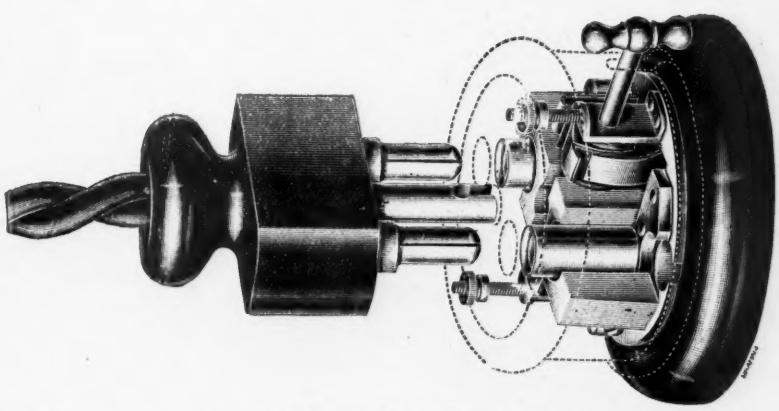


Fig. 3.—Two-pin 25-Amp. Wall Plug.

Concentric Light Diffuser.

The apparatus consists of a suitably designed metal diffuser attached to the lamp casing in the same manner as an ordinary reflector or shade. In place of the outer globe a screening shade is used, which performs the double function of subduing the light directly under the lamp and reflecting a portion of it on to the

diffuser. The light from the latter is white, even, well distributed, pleasant to the eyes, and particularly adapted to the matching of colours, which is of the utmost importance in shop lighting. Furthermore, the diffuser makes the illuminating power of the lamp independent of the nature or colour of the ceiling, and there is practically no light lost by absorption in the ceiling itself.

The Concentric Light Diffuser is particularly adapted for use in rooms having low ceilings, and is specially recommended for drawing offices, shops and in general for any interior lighting work where even distribution and steadiness of light are particularly important. It should never be used without the lower glass shade, and it is not suitable for use with outdoor lamps.

The British Thomson-Houston Co., Ltd., has devoted a great deal of attention to the proper lighting of interiors with enclosed arc lamps, and as a result of the experience obtained in this line, the following table has been compiled showing the watts per square foot required to give good lighting for various classes of work. These figures are given merely as suggestions, and a maximum and minimum figure has been given in each case to cover extremely good or particularly bad conditions. The average of the figures given will serve as a general guide. The figures are given in watts per square foot, and are sufficiently accurate for ordinary purposes for both alternating and direct current enclosed arc lamps suspended at the usual distance from the floor.

Watts per Square Foot for High-class Arc Lighting.

	Average conditions.	Variation.
Machine shops, high roofs, electrically-driven machinery, no belts	·75*	·5 to 1*
Machine shops, low roofs, belts and other obstructions	1	·75 to 1·25
Boot and shoe shops	·75	·5 to 1
Large drapery shops, light materials, *bric-à-brac*	1	·75 to 1·25
Large drapery shops, coloured material ...	1·25	1 to 1·5
Mill lighting, plain white goods	1·1	·9 to 1·3
Mill lighting, coloured goods, high looms ...	1·3	1·1 to 1·5
General office, no incandescents	1·5	1·25 to 1·75
Drawing offices	1·75	1·5 to 2

* Power based on watts at lamp terminals.

The Electrical Co.'s Showrooms.

We show in the accompanying pictures a few of the latest things which caught our eye in the course of a run through the admirably

Fig. 1.

Fig. 2.

arranged showrooms of the Electrical Co., in Shaftesbury Avenue, W.C. The body of the B type of Nernst lamp admittedly presents a somewhat unsightly appearance, and to overcome that some special designs of fittings have been got out, by which, by careful and neat arrangement, any unsightliness is avoided. Figs. 1 and 2 show specimens of Nernst fittings made in this way. An exceedingly pretty little thing, especially when seen under light, is the small table standard or bracket shown in fig 3; a number of lines are being made by the Electrical Co, in which these pearl shells are very pleasingly utilised, especially

Fig. 3.

candle screens and pendants. The one illustrated has a full-sized nautilus shell supported by an *art nouveau* metal stand, which can be made in any finish. The company has a new line of cheap and simple designs of electric radiators, and a great variety of fittings of all classes. A copy of a small coloured pamphlet, showing the general arrangement of the showrooms and contents, has been issued, and a copy can be obtained on application.

(To be continued.)

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Oct. 14th, 1902.		Week ending Oct. 13th, 1903.	
Auckland. Elec. tram cars	Value £6,760	Adelaide	Value £81
,, Teleg. apparatus ..	500	Alexandria	21
Bangkok	640	Amsterdam	128
Bombay	649	Auckland	94
Brisbane. Teleg. apparatus ..	250	Calcutta	1,262
Buenos Ayres. Teleg. cable ..	541	Cape Town	3,049
Calcutta	1,472	Delagoa Bay. Teleg. mat. ..	1,267
Callao. Submarine teleg. cable	9,800	Durban	1,323
Cape Town	7,334	,, Teleg. mat.	149
,, Teleg. mat. ..	2,568	East London	240
Colombo	31	Fremantle	165
Copenhagen. Elec. cable ..	3,446	Hong Kong	33
Durban	513	Lyttleton	105
,, Teleg. mat.	2,109	Melbourne	257
East London	378	Montreal	36
,, Teleg. goods ..	636	Perth	64
Fremantle	35	Port Elizabeth	169
Gothenburg	106	Rangoon	65
Hong Kong	25	Rotterdam	23
Karachi	137	St. Petersburg. Teleg. mat. ..	100
Kobe. Teleg. cable	1,464	Shanghai	391
Madras	42	Singapore	10
Melbourne	172	,, Teleg. mat.	16
,, Teleg. wire	805	Sydney	242
Mossel Bay	34	Townsville. Teleg. mat. ..	150
Ostend	42	Venice	110
Perth	81	Wellington	124
Rosario. Teleph. mat.	867	Yokohama	210
St. Petersburg	76	Zanzibar	33
,, Teleg. wire ..	113		
Sekondi. Teleg. mat.	304		
Sierra Leone. Teleg. mat. ..	115		
Singapore	55		
Stettin	77		
Sydney	460		
,, Teleg. mat.	46		
Tokio. Teleph. cable	1,840		
Vera Cruz	9,990		
Yokohama	91		
Total ..	£54,624	Total ..	£10,666

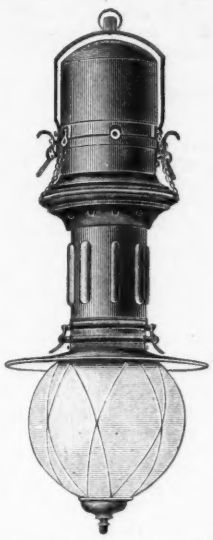
Foreign Goods Transhipped.

Colombo. Elec. light mat.	Value £12	New York. Elec. appts. ..	Value £92
Genoa. Elec. goods	10		
Rangoon. Elec. mat.	23		
Total ..	£45		

Bolsover Colliery Installation.—The British Thomson-Houston Co. has secured a contract from the Bolsover Colliery Co. for two steam alternators, each comprising one compound two-crank, C/16 engine, by Belliss & Morcom, complete with usual fittings, and capable of developing 375 B.H.P. with 140 lbs. steam pressure and working non-condensing at 375 r.p.m., direct coupled to one British Thomson-Houston Co. 250 kw. 375 r.p.m. 550-volt 50 cycle, three-phase alternating current generator. Each set is to be mounted on a combination base plate, and furnished with a direct-coupled exciter, and field rheostat for the three-phase generator and exciter. The engines for the above sets are to be capable of carrying an overload of 15 per cent. continuously. The order also includes a switchboard, comprising two generator panels and two feeder panels, with oil-break switches, instruments, &c.

The Transvaal's Electrical Imports.—The value of the imports of electrical cables and fittings into the Transvaal during the six months ending with June last is returned at £34,000, as compared with only £17,000 in the corresponding half of 1902.

Union Electric Co.'s Specialities.—Last week the Union Electric Co., Ltd., of 151, Queen Victoria Street, E.C., was "at home" to a number of electrical engineers and representatives of the technical Press. A large variety of arc lamps, motors, rheostats, instruments, &c., was shown. One of the principal exhibits was the "Miniature" arc lamp, fitted up for interior lighting; we recently illustrated this lamp (p. 217), which is now made suitable for use, two in series, on 250 volts. Another innovation was the "Excello" intense-flame arc lamp, with parallel carbons above the arc, arranged for long burning—up to 19 hours; this is illustrated below, and is intended for



"Excello" Flame Arc Lamp.

New Enclosed "E.V." Arc Lamp.

street lighting and similar purposes. It was fitted with carbons containing, in addition to the usual impregnated core, a strip of metal from end to end. A new enclosed arc lamp of short pattern, type E.V., was also shown, and a lamp for photographic and blue printing work, with an extra long enclosed arc, up to 65 mm. with 160 volts between the carbons.

A neat electromobile instrument, consisting of a moving coil deadbeat "precision" ammeter and voltmeter fixed in an aluminium case, was of interest; the ammeter scale has a reverse reading to indicate the current returned to the battery in descending hills. A new spherical motor in a nickel-plated case mounted in gimbals and free to move in all directions, with a flexible steel shaft, was shown; this is intended for the use of engravers. Judging by the numerous visitors, these periodical receptions are highly appreciated.

Bankruptcy Proceedings. — Under the failure of Ferdinand Fanta, electrical and consulting engineer, 4 and 5, Warwick Court, High Holborn, the first meeting of creditors was held at the London Bankruptcy Court last Friday before Mr. Bowyer, Assistant Official Receiver. The debtor states that he failed in April, 1895, with liabilities £1,330, but the creditors received 20s. in the £ on the amount of their claims, together with 4 per cent. interest. Since then he has carried on business first at 97, Queen Victoria Street, next in Ironmonger Lane, and latterly at Warwick Court. His capital on restarting was £1,300, the balance due to him after payment of the debts under the previous failure. In May, 1902, he assigned the lease, goodwill, office furniture and effects to Mr. P. E. Butter, who agreed to pay him £50 per month for six months and to employ him as engineer in respect of the business. The debtor adds that up to May last he was employed as engineer and manager by the Electric Glow Lamp Co., and the Electric Lamp Regenerating Co. He has furnished accounts showing total liabilities £5,109, of which £2,709 are expected to rank for dividend against assets, consisting of shares valued at £4 566. The failure is ascribed to loss on certain shares which the debtor accepted in payment for patents and to the exorbitant rates of interest charged him on borrowed money. A resolution was passed for Mr. F. E. Wright (Wright & Wiltshire, accountants) to act as trustee and wind up the estate in bankruptcy with a committee of inspection. The debtor was directed to attend the Court on November 12th for public examination, and a resolution was passed for the trustee to find security in a bond for £4,500. Mr. J. J. Chapman attended the meeting on the debtor's behalf.

Liquidation.—A final meeting of the British Blahnik Arc Light Co. is to be held on November 19th, at 57, Moorgate Street, E.C., to hear an account of the winding-up from Mr. W. H. Chantry, liquidator.

Trafford Park.—An interesting map has been issued by the Trafford Park Estates, Ltd., showing the excellent situation and great extent of this important manufacturing district, where electrical manufactories owned by the Westinghouse and half a dozen other electrical companies have risen during the past few years. The location of these and the many other works whose address is now Trafford Park is indicated.

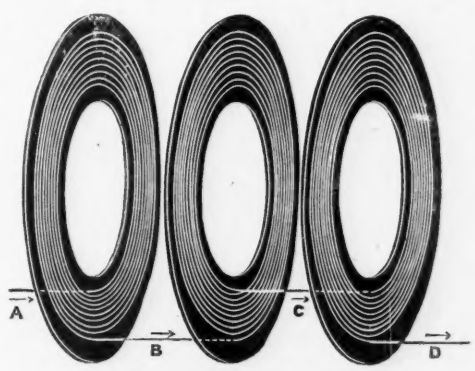
Catalogues and Lists.—Messrs. R. W. Blackwell & Co., Ltd., have just issued from the press a fine new catalogue devoted to that well-known device, the "I.T.E." circuit-breaker. A very wide range is covered, and we understand, though our patience would not extend to checking it, that there are in all about 1,400 individual types of instrument listed; but, even beyond that, there is practically no limit to the suggested combinations that can be made up from the catalogue. After 10 years of useful service on the market all the world over, the I.T.E. needs no introduction, but in this catalogue, with its large photographic half-tone pictures, and its numerous good-sized diagrams of dimensions and connections for the protection of alternating and continuous current, Messrs. Blackwell show their intention to keep the device right before the eyes of electrical engineers.

The Electrical Co., Ltd., of 122—124, Charing Cross Road, W.C., has issued a new pamphlet on the Nernst lamp, containing full particulars relating to the various types now on the market. These include, besides the A and B types, the Luna, Candle and Projector lamps. Complete data of current, candle-power, and efficiency at various voltages are given for the different patterns, and examples of installations and fittings using Nernst lamps are illustrated; it is interesting to note that the clock faces in the Clock Tower (the home of "Big Ben") are lighted with these. We understand that the Luna Nernst lamp has attained wide popularity, and that alternating current burners for this type will be on the market in a few weeks.

New Winding for Induction Coils.—An entirely new and ingenious system of winding the secondaries of induction coils and transformers has been devised by Mr. Leslie Miller, of 93, Hatton Garden, E.C. According to this device, the secondaries of coils to give from 10-in. to 18-in. sparks are made in from 700 to 1,200 separate single wire sections, with a disc of paper between, continued from one to the other without any joint in the wire or break in the paper. This new method of winding will be readily understood from the accompanying figure. For the sake of clearness, this shows the sections separated from one another by a wide distance, instead of being actually wound on the top of one another and afterwards strongly compressed together. The winding commences at A on the paper disc shown black, and is continued to B and back to C without any break, and then (on a paper disc previously threaded on the wire) to D, and so on, till the source of wire comes to an end. A joint is then made, on the outside only, and the winding continued.

It is evident that this method of winding is in accordance with theory, and the increased efficiency of coils so constructed fully confirms this. It has the following advantages:—

1. An internal breakdown, owing to wires coming together between which a high potential difference exists, cannot possibly occur. There is a safety margin of 500 per cent. or more in the



New Winding for Induction Coils.

paper discs, and the separate turns of wire, not being actually wound on the top of one another, can even be bare metal, although, for convenience, they are silk covered. The whole insulation of the secondary winding is very high.

2. The secondary winding can be compressed to any extent. This probably stops internal brush discharge, and largely accounts for the increased efficiency.

3. Low ohmic resistance of secondary. This makes the new coils specially suitable for charging Leyden jar condensers, such as are used in wireless telegraphy and medical high frequency apparatus

4. The coils will stand any climate. It is impossible for the wires to shift after the sections have been compressed.

The superiority of coils constructed in this way over the best of the old section-wound type has been clearly demonstrated. A 12-in. coil worked with 24 volts and an ordinary mercury break will fully light up five or six X-ray tubes at once, connected in parallel. By a slight modification of the winding machine, it can be used to wind non-inductive resistances, &c.

We recently had the pleasure of inspecting the process, which is carried out by means of a very simple machine, which winds the wire in a flat spiral without in any way injuring it or the insulating covering. We were also entertained with a variety of extremely interesting demonstrations of high frequency discharges, X-rays, ultra-violet light, &c., by the enthusiastic inventor, and we can heartily recommend a visit to his workshop as a means of passing a pleasant half-hour.

Trade Announcements.—Messrs. W. T. Henley's Telegraph Works Co. have removed their offices from 27, Martin's Lane, Cannon Street, E.C., to Blomfield Street, London Wall, E.C.

The Klein Engineering Co., Ltd., Manchester (condensing and water cooling specialists), have added another new branch to their general engineering business, they having made arrangements with Mr. Charles Ingrey, of London, for the sole right for the manufacture and sale of his patent automatic weighing and recording machinery. The apparatus is not a measuring device, but weighs and records the actual weight of the materials it deals with, and is so constructed that materials may be delivered to it by means of a crane, skip, or grab, travelling belt, conveyor, &c.; it is adapted for dealing with coal, coke, metals, ores, cement, grain, &c., in quantities from 10 to 200 tons per hour, and may be utilised for delivery of coal to boilers from overhead bunkers, loading and unloading boats, &c., and is specially adapted for weighing and recording the exact weight of coal in each tub at collieries at the rate of five per minute. A small leaflet has been placed in circulation, giving explanatory illustrations of the Ingrey system.

Screw and Wire Gauges.—A table of screw and wire gauges, compiled by Colonel A. H. Bagnold, R.E., has been issued by the *Model Engineer*. The data include Stubs's steel wire gauge, Morse twist drill gauge, the Imperial standard, Stubs's iron wire, the Brown & Sharpe wire gauges, and the wood screw gauge. Pitches and outside diameters of screws, tapping sizes, &c., are given, with the equivalent dimensions in inches and millimetres. The table should prove a useful one for reference; it can be obtained from the *Model Engineer*, 35—39, Temple House, Tallis Street, E.C.

Auction Sale.—Messrs. Wheatley Kirk, Price & Co. are to offer for sale by auction as a going concern, at the Albion Hotel, Manchester, the works premises, comprising 4,105 sq. yds. leasehold land and buildings erected thereon and all the stores, machinery, &c., of Messrs. Heaton & Smith, Ltd., in liquidation. The date of the sale of the Pandon Dene electricity works is also announced among our advertisements to-day.

Sports.—The first sports meeting of the Veritas Athletic and Social Club (Falk, Stadelmann & Co.) was held at the Tee-To-Tum Grounds, Stamford Hill, last Saturday. A part of the programme had to be postponed, including the jumping contests and a five-lap relay race, owing to the early darkness.

Site for New Works.—Property (3 acres) at Kilburn, suitable for the erection of manufacturing premises, or an electric power station, is to be let or sold by Messrs. Farebrother, Ellis and Co. See our advertisements to-day.

Books Received.—"Fire Tests with Partitions," No. 74; "Fire Tests with Floors," No. 78. London: The British Fire Prevention Committee, 1903. 2s. 6d. each.

"Mademoiselle Telephone," by Paul Voncet. Troyes: *Journal des Postes*, 1903. 1.50 fr.

"Science Abstracts," A and B, No. 69, September 25th. London: E. and F. N. Spon, Ltd. 1s. 6d. each net.

South African Tramways.—Among large orders recently booked by Messrs. R. W. Blackwell & Co., Ltd., may be mentioned that for the whole of the overhead equipment for tramway extensions for the Municipality of East London, South Africa, and a similar order for the Corporation of the city of Pietermaritzburg for their new municipal tramway system.

Manchester.—Messrs. Royce, Ltd., have received the contract for lighting the premises of Messrs. I. J. & G. Cooper, Dale Street, Manchester. The installation will consist of 1,139 incandescent lights and 12 arc lamps. Messrs. Lacey & Sillar are the consulting engineers.

Canadian Patent Law.—Messrs. Rayner & Co., patent agents, of 37, Chancery Lane, W.C., write:—"We think many of your readers may be interested in knowing that great changes have just been made in the Patent Law of Canada which affect many people in this country. A large number of Canadian patents were invalidated a short time ago by legal decisions which stated that patents which had not been practically worked within the specified time, or of which a corresponding foreign patent had lapsed, were void. A new Act has just been passed revalidating these patents under certain conditions, and providing for the future that a Canadian patent should not expire merely on account of the lapsing of a foreign patent, and also giving an alternative to working by rendering the patent subject to a compulsory granting of licenses. Both these alterations are of immense benefit to patentees, for whom the former arrangement formed a great grievance. We shall be pleased to furnish any further information to persons interested."

Appleyard Conductometer.—In our article last week describing this instrument, we omitted to say that the Conductometer is patented, and that it is made by the I.-R., G.-P. and Telegraph Works Co., Ltd., Silvertown. It is supplied in two patterns: a factory pattern for wire and cable manufacturers, and a portable pattern intended for inspectors.

Rugby.—It is reported that Messrs. Willans and Robinson, Ltd., are taking up the manufacture of petrol motors for motor-cars.

ELECTRIC LIGHT AND POWER NOTES.

Addis-Abeba (Abyssinia).—According to news received, the Negus having decided to have his palace lighted by electricity, has 300 men employed in carrying out the work.

Austria.—An Austrian contemporary states that an electric power plant will shortly be installed on the Salza River. Three transmission lines and 14 sub-stations are to be erected. The capacity of the plant is to be about 73,000 H.P.

Barton.—After a year's working, the electric light plant at the workhouse has been found to have effected a saving in the lighting bill, to the extent of about £40. In consequence the Board of Guardians has decided to have the electric light installed in the old infirmary.

Bootle.—The L.G.B. has sanctioned the borrowing of £38,750 by the T.C. for E.L. purposes.

Caerphilly.—The U.D.C. has appointed Mr. A. H. Preece, of Messrs. Preece & Cardew, Westminster, at a fee of 50 guineas, to advise the Council on an electric lighting scheme for the town.

Cannock.—The U.D.C. has sealed a contract with Messrs. Whittaker Bros., for electric lighting in the town.

Cottesloe, West Australia.—An electric lighting scheme has been carried out in this township, which is 7½ miles from Perth, and is practically a suburb of that city. Parliamentary powers were owned by a syndicate, which failed, however, to put them into force. Two months before their threatened expiry, Messrs. Splatt, Wall & Co., of Perth, purchased the rights, erected four miles of mains, and commenced a supply within the specified period. The plant consists of two B. & W. boilers, a Mather & Platt steam dynamo, a Sturtevant set, and a Chloride storage battery. Street lighting is in operation with glow lamps, on a system patented by Mr. L. J. B. Wall, whereby the lamps are automatically extinguished at midnight. The mains now comprise 40 miles of cable, and over 80 private houses are supplied, in addition to business establishments. Energy is supplied at 11d. per unit, a very low rate under the conditions.

Coventry.—The L.G.B. has held an inquiry into the application of the City Council for permission to borrow £5,000 for the purchase of electric motors for hiring purposes. Details were given by the electrical engineer, who showed that the result of an expenditure of £2,000 last year had been to increase the energy sold from 77,000 units in the quarter ending June 30th, 1902, to 139,000 units in the corresponding quarter of 1903, and to decrease the cost of production by not less than 37 per cent., and since the reduction of the tariff for power purposes he had obtained orders for motors of a total H.P. of 99. The loan of £5,000 would enable the Corporation to purchase motors of a total H.P. of 1,200, and it was probable that this would be all that was required, as when the manufacturers began to find out the many advantages of electric power, they would purchase their own motors rather than hire them. The £5,000 would be expended in three years. The time of repayment sought for the loan is 15 years.

Dalmatia.—A large central electric power station is approaching completion near Scardona, Dalmatia. It has been established by La Società per l'Illuminazione delle Forze Idrauliche, in Dalmazia, to utilise the water power of the River Kerka. It is estimated that 5,000 H.P. is available.

Dutch Guiana.—The Governor of Paramaribo is authorised to raise a loan of 300,000 fl. for lighting the city by electricity.

Gravesend.—An electrical exhibition has been held at the Town Hall, and it remained open for a week. The borough electrical engineer (Mr. C. F. McInnes) first made the suggestion that such an exhibition should be held, and the Town Council promoted the idea with great energy.

The T.C. has received from the L.G.B. sanction to borrow £9,102 for electricity supply purposes.

Haydock.—The U.D.C. has appointed a committee to consider the advisability of applying for a prov. order for E.L.

Hereford.—At a meeting of the T.C., the Electric Lighting Committee was empowered to apply for a further loan of £1,500 for electric light extensions.

Herefordshire.—The L.G.B. has granted permission for the County Council to raise a loan of £2,450 for E.L. purposes at Binghill Asylum.

Heysham.—The D.C. has unanimously decided to apply for a prov. order for electric lighting in view of the expected development of the district.

Italy.—Application has been made on behalf of the municipal authorities of Briga Marittima for a concession to put down plant to utilise the water power of the River Levenza, near Madonna, for the generation of electrical energy for lighting and power purposes.

London.—Islington.—The Lighting Committee of the B.C. in a report stated that the electrical engineer had impressed upon them the importance of encouraging a demand for electricity during the hours of daylight. To obtain a motor load it was essential that the present charges should be modified, and the mains extended to the manufacturing areas at the following estimated cost:—High tension feeder from works to end of Brewery Road at

Caledonian Road, £409; mains, including feeder and distributor in Brewery Road, £895; low tension distributor, York Road, for Belle Isle district, £301; high tension jointing and connections to switchboard, &c., and panel for high tension feeder, £50; services and service boxes for 20 power consumers, £245—total, £1,900. The Committee recommends:—"(*a*) That to encourage an increased day load the uniform flat rate of 2d. per unit be modified for all electricity for power purposes consumed between the hours of midnight and 6 p.m. by the adoption of the following sliding scale:—For all units up to 2,000 per annum, 2d.; from 2,000 to 20,000 units per annum, 1½d. per unit; from 20,000 units per annum, 1¼d. per unit. (*b*) That application be made to the London County Council for sanction to borrow £1,900 for the purposes set out by the electrical engineer.

St. Pancras.—The B.C. has decided to apply to the L.C.C. for sanction to borrow £34,343 for the purpose of arc lighting extensions, which the Electricity Committee will effect as speedily as possible.

Macclesfield.—The Corporation at the last meeting decided that a municipal electric scheme should be proceeded with forthwith, and that instructions be given to the Electricity Committee to take the necessary steps.

Maidenhead.—The T.C. at the last meeting agreed to supply the Thames Valley Launch Co. with energy through a transformer to be placed near Boulter's Lock at a cost of £500. The company will pay interest on that sum at the rate of £10 7s. per cent., and will take a minimum supply of 6,000 units per annum at 3d. per unit. It was reported that the cost of production per unit had been reduced since January from 2·47d. to 2·21d., and that, notwithstanding the reduction in price to private consumers to 5d. per unit, the undertaking was now being worked at a small profit.

Manchester.—The electricity engineer to the Manchester Corporation, Mr. G. F. Metzger, has resigned his position. Differences appear to have arisen between the Electricity Committee and Mr. Metzger as to the terms of his engagement, and the matter was discussed at a meeting of the Committee last week. The meeting was a private one. An official account of the proceedings furnished by the chairman merely states the fact that, after discussion, Mr. Metzger tendered his resignation, which was accepted. It is an open secret, however, that the discussion occupied a couple of hours, and was of an animated description, Mr. Metzger complaining that advice given by him in a consultative capacity to another corporation—that of Burslem—had been construed wrongfully into a breach of his agreement. A resolution was passed by a majority of 17 to 3 that the matter should be dropped, but owing to subsequent action on the part of the deputy-chairman, Mr. Metzger placed his resignation on the table, and left the meeting. The matter is dealt with in our leading columns.

Middlesbrough.—At a meeting of the E.L. Committee, the electrical engineer was instructed to prepare specifications for extending the plant at the electric lighting station. The engineer called attention to an advertisement in the Corporation exhibition catalogue stating that the cost of electricity was seven times greater than gas. He thought the Gas Committee should withdraw that statement from the advertisement, for it was manifestly an unfair attempt to check the progress of electricity.

New Quay.—The Southern District Electricity Corporation has written giving the terms on which it intended to apply to the Board of Trade for a provisional order, and asking the Council to assent to them. It proposed forming a local company for constructing and running the works, the shares of such company to be offered for public subscription, preference being given in allotment to applicants in the neighbourhood, and all necessary capital not subscribed by the public being provided by the Corporation. The charges to be made by the company are as under:—To the Council for lighting 4d. per unit, for power 2½d.; to ordinary consumers for lighting 6d., for power 3d. An alternative on the maximum demand system would be—to the Council for lighting 7d. per unit for the first 100 hours per quarter of maximum demand and 3d. after, and 4d. and 2d. respectively for power; to ordinary consumers for lighting 7d. and 4d., and for power 4d. and 2½d. The Council would have the right to purchase on certain terms. The Council favoured the application, but gave no definite decision.

Ormesby.—The E.L. Committee of the U.D.C. has received from the Redcar Council a request that the former should join it in engaging an electrical expert on the question of electrical lighting. The Committee suggested that the South Bank Council should be invited to join in as well, and agreed that the fee of the expert should be limited to 50 guineas. The Council accepted the Committee's recommendations.

St. Albans.—Mr. E. Macgregor Duncan, the Council's expert, has reported favourably on the proposal of the North Metropolitan Power Co., whose average price will not exceed 4½d. per unit.

Spain.—Application has been made for a concession to put down a plant to utilise the water power of the River Mijare at Montanejos (Castellon) in the generation of electrical energy.

Spalding.—At a meeting of the Urban Council the question of electric lighting was discussed. It transpired that a private company were applying for a prov. order to provide electricity, and it was also reported that the Council was advised it could not successfully resist the application unless it applied for a prov. order itself. The Council, however, as the owner of the gasworks, did not wish to do this, and eventually the whole matter was referred to the Gas Committee.

Staffordshire.—At the annual meeting of the South Staffordshire Mines Drainage Commissioners last week, the chairman (Colonel Cochrane) intimated that four electrically-driven pumps are now at work for pumping purposes, and that ultimately 30 of that class of pump will be in operation. He also stated that the Commissioners had spent on the electrical pumping scheme, £11,000.

Stretford.—At the last meeting of the D.C., Mr. T. N. Miller was appointed consulting engineer in connection with the electricity scheme, in place of Mr. C. H. Wordingham. The appointment is for three years.

The rate for the supply of electricity to churches, chapels and Sunday schools, was fixed at 4½d. per Board of Trade unit.

The new Stretford electricity station at Longford Bridge, was experimentally running during the week.

Torquay.—Yesterday, at a meeting of the T.C., the Electric Lighting Committee recommended that the matter of the erection of the new generating station, at an estimated cost of £17,000, should be proceeded with in accordance with the previous decisions of the Committee.

Vienna.—The *Elektrotechnische Zeitschrift* gives a description of the new Vienna municipal electric power stations. Two distinct stations are to be constructed, one for the working of the tramways, the other for lighting purposes. They are constructed in close proximity to the Danube Canal. The two stations may be worked in parallel. Each of them supplies alternating current at 5,500 volts, which for tramway purposes will be converted into direct current at 500 volts.

Wakefield.—An electric light installation has been inaugurated at the Wakefield Workhouse. When the new infirmary was built a few years ago it was fitted throughout with the electric light. A short time ago it was found that the gas mains and fittings in connection with the workhouse proper were worn out, and it was decided to extend the electric lighting throughout the premises and grounds. There are now about 900 lights, and the total cost of the latest additions amounts to £1,808 15s. 9d.

West Australia.—The report of the Kalgoorlie Electric Power and Lighting Corporation, Ltd., for 1902, states that despite the fact that only a few consumers were connected prior to December 31st, the difference between receipts and expenditure in Western Australia for the whole year is a debit of only £682. The units sold in October, 1902, were 62,000, while in July last 153,745 units were sold. From the many applications and inquiries received from probable consumers, it is expected the plant will be fully loaded within a few months.

West Bromwich.—The T.C. has made application to the L.G.B. for sanction to borrow £12,217 for electric lighting purposes.

Whitby.—At the monthly meeting of the U.D.C., the Highways and Sanitary Committee recommended the Council to utilise electric power for the working of the pumps in connection with the sewage outfall works. The recommendation was approved by a large majority. It was unanimously decided to apply to the L.G.B. for sanction to the raising of a further electric lighting loan of £5,000 for the extension of cables and additional plant.

Wolverhampton.—The Lighting Committee of the T.C. recommends a system of free wiring of houses at a rental of from £40 to £65 per annum. It is considered that the adoption of the scheme will lead to a very large increase in the consumption of electricity. It is estimated that in each case the capital outlay will be £26, and the annual revenue £9 3s. 4d., or 36 per cent. on the capital outlay. A loan of £1,000 is to be applied for for the scheme.

Worcester.—The T.C. has decided to charge in future 2½d. per unit for the first hour's daily use of the maximum demand for power, and 1d. beyond.

Wrotham.—The Wrotham Electric Power Syndicate has informed the U.D.C. that it intends to apply for a prov. order for E.L. The Council generally favours the proposal, but the question of supporting the application is deferred for further information to be obtained.

ELECTRIC TRACTION NOTES.

Ashton-under-Lyne.—The Corporation tramway system, for which a sum of £100,000 was borrowed, has lately received the finishing touches. £50,000 was required for the Hurst route and car-shed, and £50,000 for the reconstruction and electrification of the old Manchester Carriage Co.'s line from the Snipe Inn (the terminus of the Manchester Corporation electric tramways) to the Stalybridge boundary; but considerable balances of the two loans remain unspent. Manchester undertook the laying of the track on the Manchester road section of the Ashton scheme at a cost equal to actual expenditure with 10 per cent. added. This contract has just been completed. The Ashton Corporation lines directly tap a population of over 100,000 in Stalybridge, Ashton, Dukinfield and Hurst. The route joins the Manchester tramway system at the terminus of the Ashton old road and new road routes.

Blackburn.—The Corporation on 7th inst. open a n w electric tramway line from Witton to Cherry Tree, which will carry passengers into the country between Blackburn and Preston.

Bournemouth.—On October 6th the Tramway Committee presented a report by Mr. C. Barber, traffic manager, on the financial working of the tramways to the end of July, being the first twelve months' running from the commencement of traffic. During this period the total working expenses had amounted to £17,336, equivalent to 6·58d. per car-mile run, this sum being exclusive of income-tax and repayment of loan and interest. The receipts from traffic amounted to £34,232, equivalent to 13·00d. per car-mile, while receipts from other sources brought the total up to £35,096 10s. 11d., equivalent to 13·33d. per car-mile. The balance, £17,760, equivalent to 6·75d. per car-mile, remained to meet income-tax, repayment of loan and interest thereon, and to be set aside as reserve and depreciation fund, or for such other purpose as might be decided upon. The above working expenses were equivalent to about 49·39 per cent. of the income. This was a very low figure, which he (Mr. Barber) was afraid would not be touched again, since renewals had in some cases been carried out at the contractors' expense. The total number of passengers carried had been 5,969,418, the average receipts per passenger being 1·37d., and the total number of car-miles run had been 631,885. He was pleased to report a freedom from serious accidents. The total number of accidents of all kinds amounted to 239, being made up of 145 collisions with other vehicles, 81 accidents to persons, and 13 miscellaneous. This meant that for 2,644 car-miles one accident had occurred, while for each 1,000,000 passengers 13 persons had met with accidents, many of which were of a very trifling nature. Alderman Lawson (chairman of the Tramways Committee) said that the gross profit for the year ended July 22nd, 1903, was £17,760. Deducting interest and sinking fund, there was a net profit of £7,965 available for the Council to deal with by applying it to reserve fund, depreciation fund, or any other purpose.

The Corporation has resolved to promote a Bill authorising tramways in Pokesdown, Southborne and Christchurch. The cost of the scheme is put down as from £40,000 to £50,000.

Cheltenham.—The T.C. last week discussed the proposed tramway extensions to Charlton Kings and Leckhampton. Mr. Nevins, chairman of the Light Railway Co., agreed to some of the conditions laid down by the committee, and intimated that the extensions would be put in hand within less than 60 days, and that he expected to have all the lines completed by May 1st. The plans for the extension were prepared by Messrs. Dodd & Dodd, civil engineers, Birmingham.

East Ham.—The U.D.C. are applying to the Board of Trade for sanction to borrow £300 to alter overhead wires, and £2,700 to purchase five electric tramcars.

Eccles.—The T.C. has authorised the Tramways Committee of Salford to proceed with the construction of lines from New Lane to Worsley Road, Winton, and thence along Parrin Lane, on condition that no charge is to be made in respect of principal and interest until the completion of the Monton new bridge.

Johnstone.—Operations are to be commenced next month for the construction of the line at Johnstone, the preliminary arrangements being sufficiently well advanced to allow of a start being made in that time. Promise is made that the line will be opened about the end of May next, or in June.

Kirkcaldy.—The Town Council has resolved to purchase seven additional tramcars, to extend the car-sheds, and to purchase another 500-H.P. dynamo at a cost of £9,500.

London.—At Tuesday's L.C.C. meeting Mr. J. W. Benn said that the average earnings of the electric trams had so far proved to be 13·47d. per car-mile, against 10·43d. per car of the horse trams. The estimate upon which they went to work, he said, was 1s. per car-mile.

Manchester.—The City Council agreed last week to pay to the Carriage and Tramways Co. a sum of £197,000 in respect of the purchase of their undertaking in the City, and also, on the recommendation of the Electricity Committee, to promote a separate Bill in Parliament in the session of 1904, to authorise the construction of additional lines and other necessary works. The chairman of the Committee informed the Council that many matters relating to the local tramways would have to be dealt with next year. Certain lines must be laid, including those round the infirmary building, rendered necessary by the traffic in the centre of the city, and also in connection with extensions in the Bradford Road, Middleton Road, and Rochdale Road districts. These interest the city only; others affect the district authorities of Sale, Altrincham and Withington, and it will be necessary to deal with them in a special Bill. An agreement has to be settled with the Corporation of Ashton, while, by the arrangement already concluded with Sale, additional links have to be formed in that district. It is further proposed to construct lines in the Altrincham district, and negotiations, Mr. Boyle said, have been opened for a line from Middleton to Heywood. For those purposes, as well as the widening of roads asked for in Withington, and for the supply of electric current on the Southern tramways, beyond Stretford, it is necessary to obtain Parliamentary powers. It is intended that the Electricity Committee should co-operate with the Tramways Committee in the promotion of the separate Bill. The gross tramway receipts in Manchester continue satisfactory. In the last week of September they amounted to £12,136, and the number of passengers carried was nearly 2½ millions.

The Manchester Corporation has received an intimation from the promoters of the West Manchester Light Railway Order that they do not intend to proceed with the clauses relating to the construction of a line from Trafford Park to Irlam, and clauses providing for running powers over the Manchester tramways. There is no intention apparently to delete from the order the power which is sought to connect the proposed railway with the Manchester Southern Tramways in Barton Road, at the junction of King Street, Stretford. As the Corporation may become lessees, and possibly owners, of such tramways, a sub-committee which has been inquiring into the matter has recommended that steps be taken to safeguard Corporation interests.

The Manchester South Junction and Altrincham Railway will probably undergo electrification in the near future. It has already to face the competition of the Manchester Corporation tramways as far as Stretford, and the further extensions of the tramways system which are contemplated in the Altrincham direction threaten still keener competition. In these circumstances the South Junction directors, as in the case of other railways, are awakening to the necessity of meeting the tramway competition by what appears to be the most effective method. They have not yet gone so far as to decide definitely upon the electrification of their system, but there is official authority for saying that the proposal is under consideration, and that inquiries have been set on foot by them with regard to the probable cost.

Newcastle-on-Tyne.—The Tramways Committee on 8th inst., considered a report from the city engineer as to the proposed widening of Benton Bridge at Jesmond, in order to permit a double line of rails to be laid over the bridge as is proposed in the latest extension scheme. He now reported that he was of opinion that the widening could not be carried out without the construction of an additional bridge; the present bridge was not of sufficient stability to carry two lines of tram rails. He suggested that a line of rails might be laid on the low road. The approximate cost of the works was stated to be:—For a single line, £3,740; double line, £4,180; new bridge for tram traffic alone, possibly £40,000; double line on the low road, £9,000. The Committee decided to make a survey of the place, to see what steps were regarded as best to be taken.

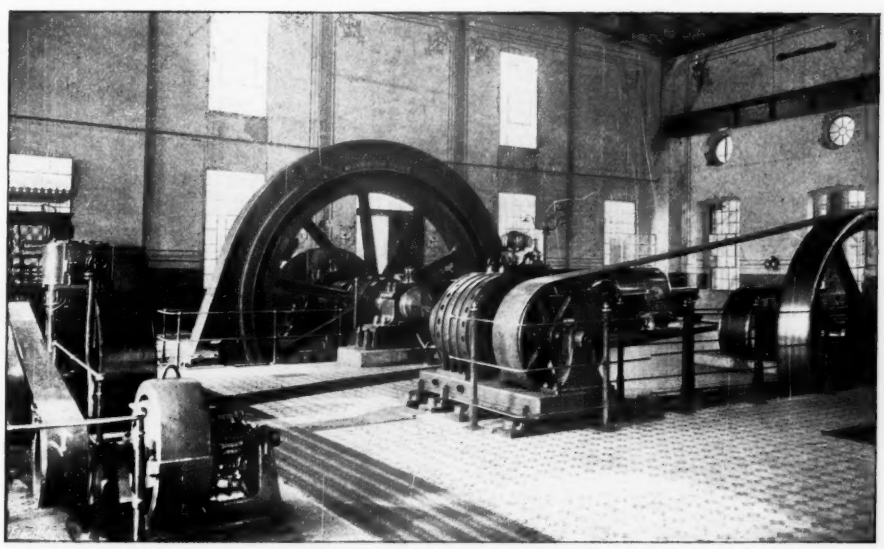
Sydney (N.S.W.).—The foundations were originally laid at Ultimo for six reciprocating vertical engines and generators. Three were installed, and these have been in use for a considerable time. The Railway Commissioners have had under consideration the question of installing the remaining three, and the *Sydney Daily Telegraph* says that, while discussing the matter, the advisability of adopting the turbine system of generator came under notice. There was a difference of opinion among the commissioners as to the form of engine which would be the most advantageous in actual operation—whether the reciprocating, as at present in use, or the turbine type. "Mr. Oliver, it is understood, advocated the former, while the other two commissioners favoured the latter type. In Mr. Oliver's view satisfactory demonstrations had not yet been given of the efficiency of the turbine system to warrant its adoption in such an important undertaking, while the reciprocating engine had been found to operate satisfactorily. In order also to instal the turbine system at Ultimo in conjunction with the present alternating plant, great additional cost would be incurred. The matter, it appears, came before Ministers, and as a result it has been decided to call for tenders for either type. These tenders were to close on September 12th. As far as can be gathered, this was the only way out of the deadlock which had arisen through the different views held by the commissioners as to the merits of the two systems."

Wolverhampton.—The report quoted from on page 641 was debated for several hours on Monday. Alderman Mander, chairman of the Tramways Committee, moved the adoption of the report and the recommendations contained therein, and this was seconded by Alderman Craddock, deputy chairman. Councillor White moved as an amendment—"Inasmuch as this Council is of opinion that direct through communication is absolutely necessary in the trading interests of the borough, the report of the Tramways Committee be referred back to them in order that such communication shall be duly provided for." Councillor Bantock seconded in a vigorous speech. On a division, there voted for the amendment 10 members, and 28 against. Several members declined to vote. Subsequently Alderman Gibbons moved a further amendment, as follows:—"That the routes on the Willenhall Road and Dudley Road be equipped on the overhead system with the view of intercommunication being established on those lines by arrangement with the B.E.T. This amendment is clearly put forth on the understanding that the Council enter into no arrangement for leasing the tramlines to any person or company." Councillor White seconded this amendment, which, on being put to the meeting, was lost, 8 only voting for the amendment and 25 against. Again several members of the Council did not vote. The original resolution as proposed by Alderman Mander, was then carried, so that Wolverhampton is now to be equipped throughout with the Lorain surface contact system of electric traction, and thus may be isolated from the outlying districts. Wolverhampton, in short, cannot now develop or expand; it must for ever remain a little place.

(Continued on page 627.)

ELECTRIC PUMPING PLANT AT DORTMUND.

One of the most important functions fulfilled by electricity in mining is that of operating pumps to drain the mines of water; for this purpose electrically-driven pumps are infinitely superior to steam, hydraulic or pneumatic pumps as regards economy in capital and working costs, convenience and reliability. An installation of this kind has recently been put down by the Oerlikon Co. for the Hösch Steel Works at Dortmund, in the Kaiserstuhl II. pit. Previously this pit was equipped with a hydraulic pump capable of raising 4 cb. m. per minute from a depth of 300 m. The inflow of water was then 1 cb. m. per minute, but the great extension of the workings necessitated a corresponding increase in the pumping capacity, and this led to the adoption of electricity as the motive power.



View of Generating Plant.

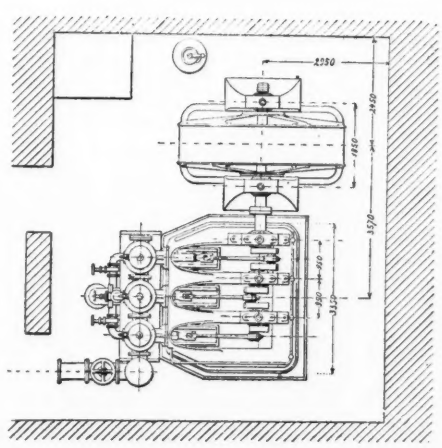
The generating station contains both water-tube and fire-tube boilers, the latter being the last installed; these are fired partly with blast-furnace gas and partly with coal. There are two steam engines, the larger of which gives out 840 H.P. at 90 r.p.m.; this is a horizontal tandem compound engine, with cylinders 680 and 1,050 mm. in diameter, and a stroke of 1,200 mm. The engine drives direct a three-phase fly-wheel magnet alternator with 30 poles, generating current at 2,000 volts, 22·5 cycles per second. The fly-wheel is 4,800 mm. in diameter, and weighs 17 tons.

The exciter is driven by a separate vertical steam engine, this method being preferred to that of direct coupling to the alternator shaft.

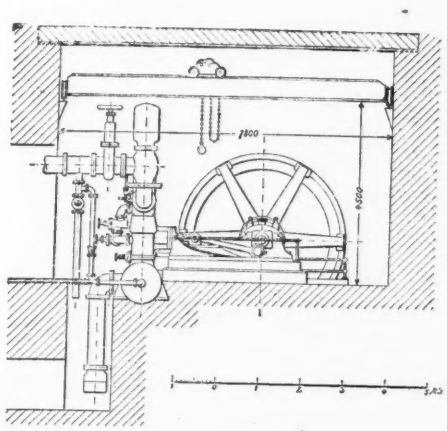
Besides the pump motor, there are various machine tools, elevators, &c., driven by the current from this generator. The efficiency of the machine at full load is 94 per cent., and at half load it is very little less.

The smaller engine is rated at 150 H.P., and runs at 105 r.p.m.; this also is a tandem compound, and has cylinders 373 and 580 mm. in diameter, stroke 700 mm. It drives by belt a three-phase generator at 337 r.p.m.

The power is transmitted to the motor in the pit by means of a specially-made cable, consisting of stranded copper wires insulated with vulcanised rubber cloth, impregnated with a special composition. Three cores thus insulated are laid up together, bound with jute, and sheathed in lead, which in turn is wound with prepared jute and armoured with steel wires, followed by an outer layer of jute.



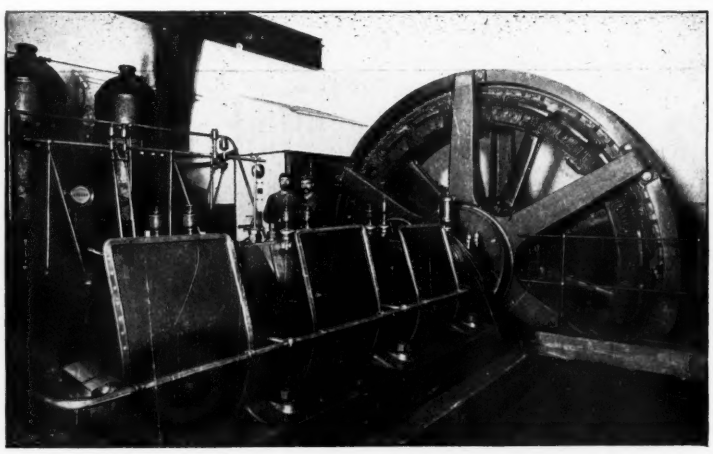
Plan of Pump Room.



Elevation of Motor and Pump.

The pump-room is 5·7 m. high, and has a floor area of 70 sq. m.; the roof consists of arches carried on iron girders.

The pump was supplied by the firm of C. Hoppe, of Berlin, and is designed to raise 5 cb. m. per minute to a height of 400 m., at 78 r.p.m. It is of the three-throw type, with pistons 225 mm. in diameter and a stroke of 600 mm. The clearance spaces are reduced to a minimum, and the air reservoirs are mounted close to the valve chambers. A bye-pass is provided to regulate the load on the pump; and a central lubricating system is fitted to supply all moving parts with oil. The efficiency of the pump when tested, including the losses in the delivery pipe, is stated to be about 88 per cent.



Motor-driven Pump.

The motor, which is of the three-phase induction type, and is coupled direct to the pump, has a normal output of 570 H.P., at 78 r.p.m., and a starting torque 20 per cent. greater than the normal torque with full load current. The moment of inertia of the rotor is made great in order to provide against the uneven torque required for driving the pumps, and for the same reason the slip is greater than usual. The difficulty met with in designing induction motors to have high starting torque while running at very low speeds is largely due to the increased magnetic leakage, which is almost unavoidable owing to the large number of poles required. In this case the diameter of the rotor is 3 m., and the air-gap measures 2 mm. The weight of the rotor is 8 metric tons. The winding of the stator consists of 162 coils embedded in 324 grooves and insulated with micanite tubes. The terminals of the star-wound rotor are brought to three cast-iron slip rings, the brushes on which are connected with a large starting and regulating rheostat of constantan sheet. By means of the latter the motor can be started on full load without taking more than the normal full-load current. When the rotor has attained full speed, the winding can be short-circuited, and the brushes raised from the slip rings.

Stator Ring.

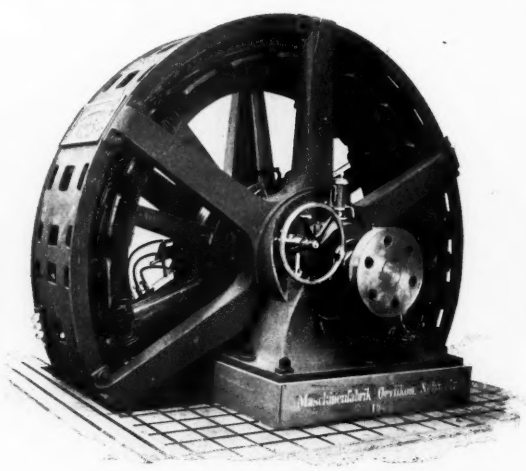
In order to be able to convey the motor through the narrow shaft and galleries to the pump room, the rotor and stator were made in halves; the windings were arranged so that the parts of the machine could be separated without disturbing the coils beyond breaking a few connections. The parts of the coils outside the grooves are arranged in three rows, so that the length of wire in each phase is the same.

The difficulties of access to the pump room entailed many modifications in the design of the motor. To compensate for the restricted dimensions of the frame, the latter is stiffened by two cast-iron spiders with six arms each, bolted to the frame, and carried on the bearings in such a way that on removing three screws the carcase can be rotated. A test was made with the rotor purposely displaced to an eccentricity of a difference of 1 mm. in the air gaps, and with the maximum magnetisation, but no deformation ensued. The external diameter of the carcase is 4 m., and its width ·9 m. The weight of the whole machine is 28 metric tons, of which 9 are sheet-iron and 1·4 copper. The rotor weighs 11 tons.

At normal load the motor absorbs about 170 amperes in each phase, with a power factor of 82 per cent. and an efficiency of 92 per cent., the slip being 2·7 per cent. The maximum torque is twice the normal torque.

These results are very satisfactory, having regard to the low speed and restricted dimensions permissible.

The pump can be started on light or full load by closing the switches before starting the generator, and running the latter up to speed; but this is not practicable when the generator is supplying power to other motors. The motor has proved fully capable of starting and driving the pump at full load, and affords a satisfactory solution of the problem set by the difficult conditions obtaining.



Complete Motor

WEST HAM INFIRMARY LIGHTING.

The ceaseless growth of the Metropolis, with its corresponding burden of sickness and poverty, has for some years

embarrassed the Guardians of West Ham Union, who have met with difficulty in providing accommodation for their inmates. To remedy this matter, the Guardians purchased an estate of 44 acres on the edge of Epping Forest, whereon they have erected, in harmony with the liberal views of their constituents, a palatial infirmary, capable of housing a total number of 674 inmates. The buildings consist of four wards holding 168 persons each, together with an administrative block, nurses' home, laundry and machinery block, and various minor buildings. The whole of the equipment of these extensive premises has been provided on a lavish scale, in accordance with the latest sanitary and hygienic ideals. It is needless to say, therefore, that electric lighting is used throughout, there being a total of about 2,000 glow lamps installed. The contract for this installation was carried out by Messrs. F. A. Glover & Co., Ltd., of 10 and 12, Garrick Street, London, W.C.; the consulting engineer was Mr. J. Buley, of Suffolk House, E.C. Some views of the generating plant, &c., are given herewith, and the following particulars relating to the undertaking may be of interest.

Hart Storage Battery.

Steam is supplied by three Lancashire boilers, each 30 ft. long and 8 ft. in diameter, manufactured by Mr. J. Thompson, of Wolverhampton; these are provided with economisers, and are capable of evaporating 7,800 lbs. of water each per hour at 120 lbs. per sq. in.

The boilers are fitted with mechanical stokers of the "E.S.E." sprinkler type, made by the Smoke Preventer Co., of Blackburn.

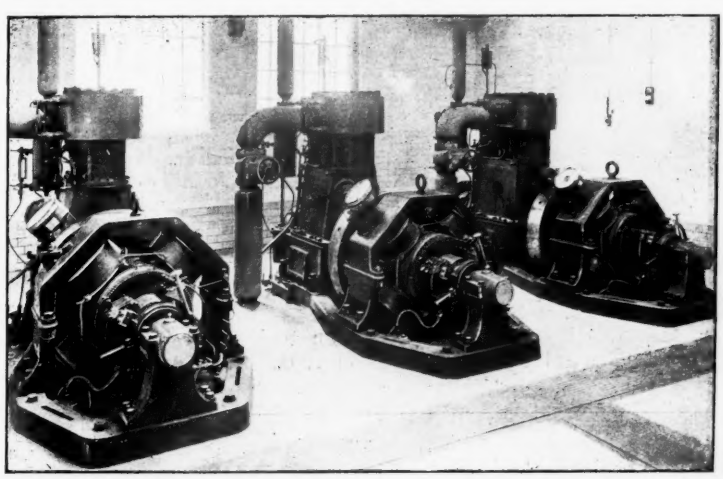
The steam pipes were put in by the Sir Hiram Maxim Electrical and Engineering Co., of London, and are of steel, arranged on the ring main plan.

The generating plant consists of three high-speed enclosed vertical compound engines, made by Messrs. W. H. Allen and Sons, Ltd., of Bedford, and direct-coupled to shunt-wound multipolar dynamos, supplied by the same firm, each having an output of 34 KW. at a speed of 550 r.p.m., the steam pressure being 110 lbs. at the engine stop valve. The engines are provided with a system of automatic forced lubrication, by a valveless force-pump driven from one of the eccentrics on the crank-shaft. The dynamos generate current at a pressure of 205 volts.

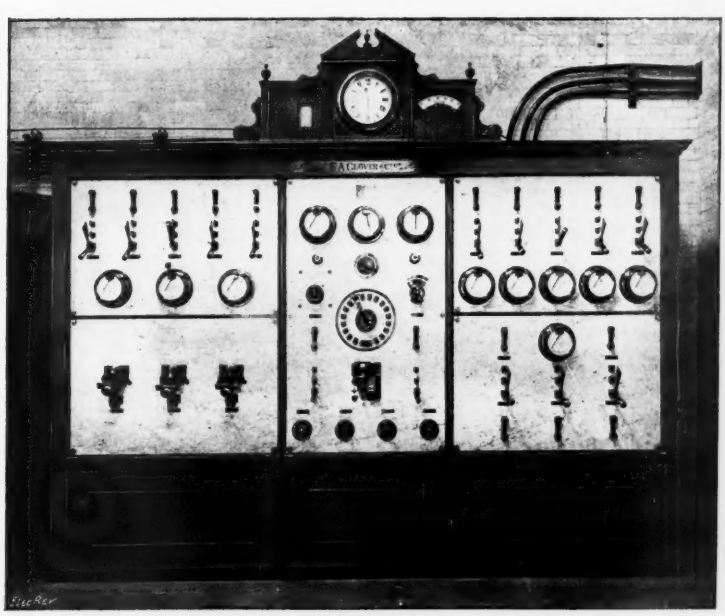
There is also a booster for charging the accumulators, which is coupled direct to a motor, both mounted on one cast-iron bed-plate.

The main switchboard is a handsome structure consisting of three panels of white marble, framed in light oak. The board is supported on a wrought-iron frame about 3 ft. from the wall, access to the back being gained by a door at one side.

The positive and negative panels are at either side of the board, and control the dynamos and feeders; the centre panel is devoted mainly to the battery and field regulating gear. Each dynamo is provided with an automatic minimum cut-out, s.p. switch and fuse for 300 amperes, and an ammeter reading to 200 amperes; for the feeders there are five 200-ampere switches and fuses on each pole, as well as five ammeters reading to 200 amperes. There are also, on the positive panel, two 100-ampere s.p. fuses, and a main 500-ampere meter indicating the total load. The centre panel carries a 20-way battery regulating switch for 200 amperes, Crawley automatic switch, charge and discharge centre zero ammeter, motor starting switch, and shunt rheostats for the dynamos and booster. There is also a 300-volt meter on this panel,



Allen Steam Dynamos.



Main Switchboard.

with a 5-way switch and a number of minor fittings. On a pediment over the switchboard a Kelvin engine-room volt-

meter, a recording voltmeter and a clock are mounted. The apparatus is all well finished and of good workmanship.

The storage battery comprises 110 cells of the Hart Accumulator Co.'s make, having a capacity of 700 ampere-hours, and arranged on wooden stands in two tiers. The connections between the end cells and the switchboard consist of bare copper rods supported on insulators on a special system.

From the main switchboard four feeders run through a subway to various parts of the building, feeding a distribution ring main. The feeders and mains are so arranged that, with the whole of the lights on, there is a maximum drop of only 2 per cent. in pressure, and the difference in pressure between any lamps in any part of the building nowhere exceeds 1 volt. The main distribution board is fixed on the ground floor of each section of the building, from which a separate pair of mains is run to each floor feeding sub-distribution boards thereon. The feeders and distribution mains consist of lead-covered concentric cables.

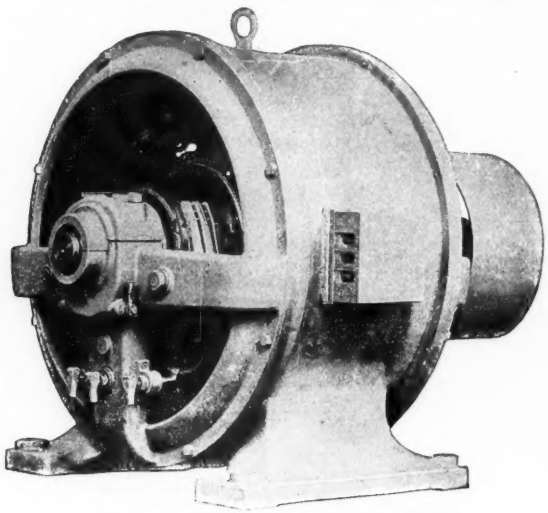
The whole of the wiring is carried out in steel tubing, except in the boiler house section, where a complete water-tight system of wiring has been adopted. There is not a single joint in the whole installation, the looping-in system being used throughout.

There are altogether about 2,000 incandescent lamps of various candle-powers, and two motors, one for running the mechanical stoker and one for the engineer's shop. Each ward is provided with two night lights, and six special surgeon's hand lamps.

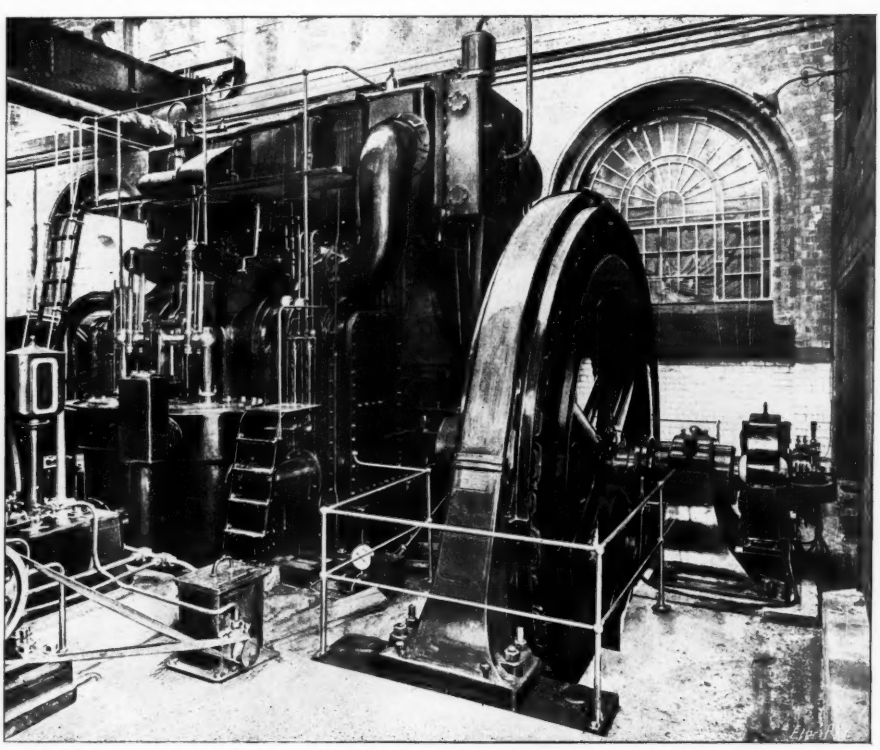
The whole of the grounds are lighted by means of cast-iron standards with a 32-c.p. lamp on each; the mains for these are run in Howard conduit.

Special water level indicators have been fitted by Messrs. Glover & Co., which show, in the pump room, the level of the water in each of the two tanks in the water towers, which are about half a mile away.

Every care was taken to ensure that every part of the installation should be carried out in first-class style, and that its working should be satisfactory and reliable. Our only complaint is that so narrow and short-sighted a view should have been taken of the true function of electricity in such an establishment as to limit its use almost entirely to lighting; for this, of course, the contractors are naturally in no way responsible, as they have to work to the specifications provided. We regret to say, however, that a separate hydraulic system has been laid down for working the various lifts, while the laundry machinery, artesian well pumps, &c., are driven by steam. By adopting a complete electric drive throughout, the capital cost would have been largely reduced, and the working costs would have been greatly improved; for, as it is, the hydraulic and laundry engines are at work all day, stopping in the evening, while the electric plant, save for charging the battery, is idle until the other engines are shutting down. It is sad to see the opportunity of putting down an up-to-date electric plant passed by.



Coventry: Two-phase Schuckert Motor.



Coventry Electricity Works: New Generating Set.

COVENTRY ELECTRICITY WORKS EXTENSIONS.

Our readers will remember that when, towards the end of 1901, Mr. J. A. Jeckell was appointed manager of the Corporation electricity works, he impressed upon the Council the fact that the only chance of making the undertaking a profitable one lay in largely augmenting the output of energy, by reducing the price and by providing a supply better adapted for motive power purposes.

It was therefore decided to push the business energetically, and to advertise immediately for tenders for additional plant to meet the probable requirements of consumers. A large number of offers were received, and after careful consideration, it was decided that the proposition of the British Schuckert Electric Co., Ltd., to supply two 600-kw. two-phase alternators, was the most satisfactory as to quality, cost, and guarantees, and their tender was accepted.

The following are the leading particulars of the new plant which has been installed, and which is illustrated herewith:—

The alternators are of the Schuckert standard revolving field type, each giving 600 kw. at 2,000 volts, 50 cycles per second, direct coupled to McLaren triple-expansion engines running at

125 revolutions per minute. The revolving field is carried on a cast-steel spider, allowing greater peripheral speeds than is permissible with cast-iron.

The field winding is mounted on brass cores, and consists of formed ribbon wound on edge, each turn being separately insulated with a special material. Each bobbin is securely held in position by two bolts, locked in such a manner as to prevent them from working loose. Any pole can be easily removed for inspection or repairs by unscrewing the two bolts without interfering in any way with the stationary armature. The armature of each machine is built up in two parts, the outside diameter being 16½ ft. The armature shell consists of a cast-iron frame of box section, enclosing the laminated plates of the armature ring. The laminations are insulated from each other to minimise hysteresis and eddy current losses. Ventilating ducts are arranged at intervals between the laminations, to allow air to circulate through the core and its windings, ample ventilation and low temperature when working being thus secured. Before leaving the Schuckert works, while the machines were still hot from the running test, the field coils were submitted to an A.C. pressure of 2,000 volts and the armature coils to 5,000 volts, between windings and frame.

The exciter for each machine consists of a shunt-wound Schuckert dynamo, type V. 85, mounted directly on an extension of the alternator shaft. Each exciter is designed for an output of 370 amperes at 65 volts, the maximum exciting current required for each 600-KW. set on full non-inductive load being 210 amperes.

The steam engines are of the McLaren vertical, triple-expansion surface-condensing type, each developing 1,100 I.H.P. The diameters of the cylinders are 22, 31½ and 44 in., with a stroke of 24 in.

At the official tests the following results were obtained :—

	½ load.	¾ load.	Full load.
Total indicated horse-power ...	511	681	936
Combined efficiency of plant...	82·1 %	84·5%	82 0 %
Steam used per I.H.P.-hour ...	13 59 lbs.	13·43 lbs.	14·6 lbs.
Steam used per KW.-hour ...	22·24 „	21 33 „	24·18 „
Coal used per I.H.P.-hour ...	2 45 „	2 66 „	—
Coal used per KW.-hour ...	4·01 „	4·23 „	—

It will be seen from the above figures that the machines are designed for most efficient working at three-quarter load.

The original Fowler switchboard used for the single-phase machines has been utilised for the new two-phase system, the necessary alterations being carried out by the contractors to the designs of Mr. Jeckell, without stopping or interfering in any way with the running of the station.

A considerable number of two-phase motors have been supplied by the British Schuckert Electric Co., Ltd., and are in successful operation in many workshops and factories in Coventry.

An example showing one of the advantages obtained by electric driving of machinery may be of interest. A customer, having part of his plant driven by a gas engine and the remainder by a Schuckert two-phase motor, had a break-down with the engine. The entire load was thrown on to the motor, which carried an overload of 60 per cent. without harm for a considerable period. This is an eloquent tribute to the merits of the motor.

The financial results obtained during the first six years' operation of the Coventry Corporation electricity works were very unsatisfactory, the deficit on this period of working being £8,890, which of course had to be provided by the ratepayers. Later results obtained under the management of Mr. Jeckell with the new plant are far more satisfactory. The reports show that the station charges have been considerably reduced, and although the number of units sold has increased by 39 per cent., the amount of total cost is less; it is hoped, therefore, that the electricity undertaking, instead of burdening the rates, will in a very short time be able to contribute towards them.

Germany.—The Electricitätswerk Alt. Damm Gesellschaft is the name of a company which has been formed to establish a central station in the town of Alt. Damm for lighting and power purposes.

Tenders are about to be invited for the establishment of a central electric lighting station in the town of Berndorf (Baden).

ELECTRIC TRACTION NOTES.

(*Continued from page* 622.)

Newport (Mon.).—Mr. H. F. Parshall has reported to the Electricity Committee upon a claim of the British Westinghouse Co. for £387 15s., being £12 18s. 6d per car on 30 cars, made up as follows:—Additional destination and indicator boards, 19s.; illuminated destination indicators, instead of ordinary, and additional stanchions and fittings, £7 14s. 6d.; and more expensive form of trolley stand, £4 15s. Mr. Parshall stated that he considered the firm entitled to be paid for the first item. The Committee, after consideration, decided to offer payment of the first two items, £260, 5s. in settlement of the claim.

Salford.—Some new routes in connection with the Salford Corporation tramway system were opened last week. Passengers may now travel either *vid* Liverpool Road or *vid* Blackfriars and Chapel Street to the Ship Canal end of Ordsall Lane at a reduced charge. The cars on this service pass through a densely-populated district. Eventually arrangements will be made for these cars to run to the Trafford Bridge terminus. The other service is a circular route, *vid* Broughton and Cross Lane, to Trafford Bridge. There has been a re-arrangement of the fares.

Swansea.—The report of the Swansea Improvements and Tramways Co. for the half-year ended June 30th last, states that the gross receipts of the tramways undertaking amount to £12,982, being an increase of £718, and expenses (including debenture and other interest) to £9,564, an increase of £529. The increase in expenses is caused almost entirely by increased local taxation. The profit on the half-year's working is £3,417, which, added to the balance of £204 brought forward, makes a total of £3,621 at credit of profit and loss account. The directors recommend that this sum be applied in reduction of amount due to the British Electric Traction Co., Ltd., £1,000; to dividend on 984 preference shares at the rate of 6 per cent. per annum, and on 4,016 preference shares at the rate of 5 per cent. per annum; leaving to be carried forward £1,322. The working of the Mumbles Railway and Pier shows a deficiency. The gross receipts amount to £8,247, as compared with £7,598 for the corresponding period of last year, and expenses to £10,791, as compared with £10,002. As in the case of the tramway undertaking, the increase of £789 in the expenses is largely owing to increased local taxation. The deficiency on the half-year's working of £2,543 is carried forward.

Walsall.—With the object of providing sufficient terminal accommodation for the proper and expeditious working of the tramway traffic with a quicker service, the line of tramways from Princes Street to the Brown Lion Hotel at the Pleck is to be reconstructed, and a double line substituted, at a cost of £2,345.

TELEGRAPH AND TELEPHONE NOTES.

Pacific Cable.—It is stated in the *St. James's Gazette* of 12th inst. that Mr. Chamberlain, as Colonial Secretary, urged upon the Colonial partners in the ownership of the Pacific cable to agree to a conference in connection with the management of the enterprise. It is well known that great interest was shown in the ELECTRICAL REVIEW for the accomplishment of a British line to Australia and to other colonies, to be free and uncontrolled, and we think the successful working of such cables is most desirable, and could have been achieved. A very cursory examination of the Pacific Cable Act, 1902, showing accounts for the period ended March 31st, 1903, will elicit the fact that the cost for this cable has so far exceeded estimates recommended by early advocates as to preclude any further dissection or comment. The power to collect a revenue has been apparently restricted, and more than 50 per cent. of the rate collected is simply paid away!

Paris and Rome Telephone.—A Paris paper says that the telephone between Paris and Rome is ready for working, and that the Postal Administration is ready to open it.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Guadeloupe-Martinique	May 7, 1902	
Puerto Plata-Martinique	July 10, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Bolama-Bissao	Aug. 4, 1903	October 7
St. Jacques-Haiphong	Sept. 28, 1903	October 7
Landlines		
Communication with Puerto-Barrios	July 28, 1903	

Wireless Telegraphy.—It is announced that the Mors Co. of Paris have secured a contract from the Western Railway Co. of France and the London and Brighton Railway Co. for the installation of a system of wireless telegraphy between Dieppe and Newhaven. The system to be employed is that known as the Octave Rochefort.

Mr. Marconi, if nothing else, is a born courtier. He comes across the Atlantic, as he has often done before, with that

exuberant spirit no failure seems to damp—in public. Mr. Marconi states that he has been entirely successful, and with a few mechanical improvements which he intends introducing at Poldhu and Canadian stations, he will be opening up business commercially very soon. Then follows on October 12th in the *Daily Mail* the following:—"Mr. Marconi speaks of a time not far remote when Marconigrams will be flashed across the Atlantic from England to America." On arriving at Liverpool by the *Lucania* on Saturday, he said that Marconigraphy would then be made into a commercial undertaking. "I have got quite beyond the experimental stage" said he, "and you may depend upon it that there will be no question of our messages going astray. They will pierce the thousands of miles of wind and fog and rain between the two Continents with just as much assurance of reaching their destination as that the sun's rays reach us." It is needless to state that the sun's rays reach us with more or less success. We can best depend upon rain on this side.

CONTRACTS OPEN AND CLOSED.

OPEN.

Beckenham.—November 9th. Electric wiring under free wiring scheme. See "Official Notices" to-day.

Bridgend and Cowbridge.—October 17th. The Board of Guardians invite tenders for electric light wiring for the Bridgend Workhouse. Mr. P. J. Thomas, architect, Bridgend.

Devonport.—October 24th. Motor-driven booster for the electricity department. See "Official Notices" to-day.

G.W.R.—October 19th. Tenders are wanted for a year's stores, including electrical lamps, carbons, telegraph apparatus and instruments, copper and other wire. See "Official Notices" October 2nd.

Halifax.—October 21st. 750-KW. continuous current dynamo and horizontal engine; two Lancashire boilers; three-phase cable, for the Corporation. See "Official Notices" October 9th.

Harrismith.—October 19th. Water-tube boilers, 25 and 80-KW. steam alternators, and other plant. See "Official Notices" September 25th.

Johannesburg.—November 16th. Gas producer plant; gas engines and dynamos. Alternative:—Water-tube boilers, steam engines or turbines, electric generators, and other plant. For the municipal tramways and electrical supply scheme. See "Official Notices" August 28th.

Kilmarnock.—November 18th. Lancashire boilers; engines and dynamos; crane; battery; and switchboard for electricity scheme. See "Official Notices" October 9th.

Leeds.—October 17th. Surface condensing plant for the electric lighting department. See "Official Notices" October 2nd.

London.—November 3rd. Engine, dynamo, wiring, &c., for an installation at the Abbey Mills Pumping Station at West Ham, for the L.C.C. See "Official Notices" October 2nd.

Nelson.—October 19th. One 400-KW. engine and dynamo. See "Official Notices" October 9th.

Newport (Mon.).—October 24th. Triple and concentric paper cable. See "Official Notices" to-day.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Salford.—October 19th. Sundry machinery for the Pendleton central car depôt. See "Official Notices" September 25th.

Salford.—October 19th. Electric lighting of the Pendleton Central Car Depôt. Specifications £3 3s., from the tramways manager.

Spain.—October 22nd. Tenders are being invited until the 22nd inst., by the municipal authorities of Aranjuez (province of Madrid), for the concession for the electric lighting of the town during a period of four years. Tenders are to be sent to El Secretario del Ayuntamiento de Aranjuez (Madrid province), whence particulars may be obtained.

Spain.—October 26th. The Municipal Authorities of Munera (province of Albacete) are inviting tenders until the 26th inst. for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Munera (Albacete).

Swansea.—October 31st. Permanent way, rails, special work, overhead equipment, cables, ducts, &c., for tramways. See "Official Notices" September 25th.

Swansea.—October 31st. Ducts, troughs, cables, wires, street boxes, &c. See "Official Notices" September 25th.

Todmorden.—October 31st. Lancashire boiler; steam dynamos, pumps, switchboard, battery, cables, crane, &c., for electricity supply. See "Official Notices" October 9th.

CLOSED.

Aston Manor.—The U.D.C. has received the following tenders for the complete overhead equipment of about 5 miles of tramways in the district:—

Dick, Kerr & Co., Ltd.	£5,155 14 8
The Brush Electrical Engineering Co., Ltd. (accepted)	4,742 10 7
R. W. Blackwell & Co., Ltd.	5,225 0 0
Geo. Law (amended)	6,333 16 0
Geo. Trentham (amended)	5,819 4 6
F. W. Smith & Co., Ltd.	5,321 5 7

In addition to the contract placed with Messrs. Johnson and Phillips, the Council has accepted the tender of Messrs. Mather and Platt, Ltd., for the following motors:—Semi-enclosed type, 50, 75 and 100 B.H.P.; open type, 50, 75, 100 and 300 B.H.P.

Belgium.—Five German and four Belgian firms competed for the contract for the supply of 16 electric tramcars for the municipal authorities of Liège, the lowest being that of the Helios Co., of Ehrenthal, Cologne.

Bradford.—The Corporation Electricity Committee has accepted the tender of Messrs. Cole, Marchent & Morley, Ltd., for additions to two 2,000-H.P. engines at the generating station, at £619.

Gravesend.—The T.C. has accepted the tender of the British Westinghouse Co. for a generating set, at £996.

Grimsby.—The T.C. has accepted the tender of Messrs. Waygood & Otis, Ltd., for an electric lift at £130.

Holland.—The Electrotechnische Fabrik Rheydt (M. Schorch & Co.), of Rheydt, Germany, have secured the contract for the establishment and equipment of a central station at Utrecht to furnish current for electric lighting purposes and for the working of the electric tramways.

Horsham.—Last week the Urban Council accepted Messrs. Johnson & Phillip's tender at £2,800, for cables in connection with the extension of electric mains. For condensing plant and cooling tower, the Wheeler Condensing Co.'s tender of £1,095 was accepted.

Liverpool.—The Electric Power and Lighting Committee has accepted the tender of the Wheeler Condensing and Engineering Co. for condensing plant for the first section of the new station at Lister Drive, subject to the approval of final plans and specifications, at £11,975.

Kirkcaldy.—The T.C. has accepted the offer of the Alliance Electrical Co. for fitting up the Beveridge Halls at a cost of £809.

London.—The following is a list of the tenders sent in for the wiring of the new Hall of the Royal Horticultural Society in Vincent Square, S.W.; Messrs. Handcock & Dykes are the consulting engineers:—

National Electric Construction Co. (accepted)	£778
G. E. Taylor & Co.	810
Robert Dawson & Co.	810
Drake & Gorham	854
Strode & Co.	867
Buchannan & Curwen	1,080
Duncan Watson & Co.	1,106
Pearson & Co.	1,175
Marryat & Place	1,337

Engineers' estimate, £790.

Maidenhead.—The T.C. has placed an order with the Klein Engineering Co. for a cooling tower at £240; and for piping and pumps with Messrs. Aiton & Co. at £257.

Paisley.—Mr. Murphy has placed a large order for poles and fittings for his electric tramway system, with Messrs. R. W. Blackwell & Co., Ltd.

Sheffield.—The T.C. has accepted the tender of the Thermit Co. for the work in connection with welding the rail joints on the new track in the Wicker, at £115.

Spain.—Messrs. Bernaheu & Soldevilla, of Barcelona, have secured a contract for a 200-H.P. four-cylinder Fielding and Platt gas engine, for the central station of the Sociedad Electrica de Azuaga.

Swindon.—At last week's meeting of the T.C., the town Clerk reported correspondence with Messrs. J. G. White & Co., Ltd., with regard to their tender for the construction of the permanent way for the tramways, stating that they were willing to supply rails of British manufacture at an additional cost of 4s. per ton, making a total additional cost of £138. It was resolved that the offer be accepted, and that their tender be amended accordingly. The tender of Mr. A. J. Colborne, at £3,233 17s., for the erection of the car depôt stores, repair shops, &c., has been accepted.

FORTHCOMING EVENTS.

Saturday, October 17th.—At 3 p.m. Junior Institution of Engineers. Visit to the new Vauxhall Bridge Works.

Thursday, October 22nd.—Institution of Electrical Engineers (Leeds Section). Paper on "Some Notes on Steam Turbo-Electric Generating Plants," by G. Wilkinson.

Friday, October 23rd.—At 8 p.m. Junior Institution of Engineers. Annual general meeting at the Westminster Palace Hotel.

NOTES.

Drawing Office Equipment.—The following is an abstract of paper read before the American Society of Mechanical Engineers, June, 1903, by Mr. John McGeorge:—

Lighting.—The first point to be considered in the equipment of a drawing office is light. Daylight is, of course, the best, but is not always obtainable. Windows should be as high and as near the ceiling as possible, and the man next to the window should have control only of the shades on the lower half. For artificial lighting there are only two satisfactory methods. The first is by arc or Nernst lamps, the light being thrown up and reflected from dead-white ceilings and walls. Photos are reproduced of a drawing office lighted by this method and by daylight, from which the light appears to be well diffused. The reflectors below the lights are not opaque, but sufficiently translucent to prevent a dark shadow underneath them. The other method is the individual lamp for each board. A simple form of lamp is shown.

Ventilating.—A draughtsman cannot do his work properly without a plentiful supply of fresh air. The air should be changed as frequently as possible, and if natural ventilation is not sufficient, exhaust fans should be used.

Desks.—The most approved method is to give each man a tilting desk to himself. The Svenson board can be placed at 60°, 45° or flat, and is provided with a balanced parallel rule. This is a great blessing to anyone troubled with bilious headaches. Sufficient room should be given to each man for reference drawings, two drawers for drawings, one for tools and instruments, and one for note-books and notes. There are several objections to the vertical board. One is the men's objection to having to hold their arms level with their shoulders all day long; and another is the difficulty in referring to reference drawings. The superintendent objects to them because they divide the drawing office off into stalls.

Space per Man.—The number of square feet which may be allowed to each man, depends upon three considerations:—(1) The convenience of the man, allowing ample room for reference, drawings, &c.; (2) ventilation; and (3) supervision. The supervisor should be able to get about without disturbing the men. The American Bridge Co. allows considerably more than 100 sq. ft. of space per man. Plans are given of the above-mentioned company's drawing offices, also those of McClintock, Marshall & Co., the Wellman-Seaver-Morgan Co., and the Wellman-Seaver Engineering Co. Attention is drawn to the "Universal drafting machine" previously illustrated and described in our "Notes" columns, and by means of which 25 to 50 per cent. saving in time may be effected.

Speed of Electric Cars.—At Brentford last week, Sidney Blackler, James Dowse and Ernest Downham, drivers in the employ of the London United Electric Tramways Co., were summoned for driving their cars at speeds exceeding 10 miles an hour—18, 15 and 16 miles an hour respectively, the first two at Uxbridge Road, Southall, and the other at Richmond Road, Twickenham. The police measured off lengths of the roads and timed the cars with stop watches.—In the case of Downham, evidence was called, and one passenger put the pace at "3 to 6 miles an hour," and another at "certainly not above 10 miles an hour."—The defendant deposed that his topmost speed position at the time was 7 miles an hour.—Mr. Montagu Sharpe asked what the maximum speed of the cars was?—Mr. Oswald Hanson (for the company) said they ran up to the 10 miles an hour limit.—The reply evoked a burst of laughter from Mr. Sharpe and his nine brother magistrates, and Mr. Sharpe, having questioned defendant, said the car weighed 10 tons, was on the down grade, and was overtaking a trotting van. He imposed a fine of 20s., including costs, in each case.—Mr. Hanson said the men had to pay their own fines.

The hearing of the summonses against four other drivers in the service of the London United Electric Tramway Co. for exceeding the statutory speed of 10 miles an hour was again adjourned on 9th inst. at West London Police Court, the Board of Trade test not having yet taken place.

Electrical Resistance Furnaces.—A paper was read by Mr. F. A. J. Fitzgerald on September 17th last before the fourth general meeting of the American Electro-chemical Society at Niagara Falls entitled a "Note on Some Theoretical Considerations in the Construction of Resistance Furnaces." These apparatus the author divides into two classes according as the current passes through the whole charge, or along a definite path or paths. The graphite (or graphitising) furnace belongs to both types; for, although at first the current is confined to the core of carbon rods owing to the non-conducting capacity of the anthracite charge, when this is converted into graphite, it passes the current and communicates the heat to the coal further from the centre. In the electrode furnace the heat is mainly generated outside the articles under treatment. The electrodes, which are to be converted into graphite, are packed amongst granular carbon, and, since the resistivity of the latter is much greater than that of the rods, the heat energy is mostly developed in the granules. This variety of furnace has the advantage of enabling a large mass of low resistance material to be treated without the use of excessively heavy currents. The carborundum furnace is designed on somewhat similar lines, the heat being generated in a core of rods or granular carbon; but care has to be taken to prevent the temperature from rising too high; or the carborundum may be decomposed and the silicon volatilised. A variant of the carborundum furnace, for moderately high temperatures, has been designed by Acheson (U.S. patent 723,631, March 24th, 1903), in which several cores are "definitely spaced with relation to each other at distances largely determined by the heat conductivity of the charge, the duration of the operation, and the superior and inferior temperature limits of the operation."

The author proceeds to remark that in all these furnaces the electrical resistance is a variable quantity, generally diminishing towards the end of the run, and it is not possible to effect regulation inside, except in the case of the electrode furnace where some adjustment may be obtained by varying the spaces between the piles of electrodes. Next, the author gives some mathematical formulæ covering the distribution of heat in these furnaces, thus: If a cylinder (core) with radius ρ_1 and length L is kept at a constant temperature θ_1, the quantity of heat, Q, passing through the surrounding material, the inner surface of which is at the temperature θ_2, per second is

$$Q = 2\pi\rho_1 L K (\theta_1 - \theta_2)$$

where K is a constant. Thus

$$\theta_1 - \theta_2 = \frac{Q}{2\pi\rho_1 L K}.$$

If the material outside the core is also a cylinder with a radius of ρ_2, a heat conductivity of K^1, and a temperature at its outer surface of θ_3,

$$Q = \frac{2\pi L K^1 (\theta_2 - \theta_3)}{\log. \frac{\rho_2}{\rho_1}}$$

while between the outside of the cylinder of material under treatment and the walls of the furnace, the passage of heat per second is similarly

$$q = \frac{2\pi L k (\theta_3 - \theta_4)}{\log. \frac{\rho_3}{\rho_2}}$$

or, if $\rho_3 - \rho_2 = t$, and is very small,

$$q = 2\pi L k (\theta_3 - \theta_4) \frac{\rho_2}{t}.$$

Now, since the efficiency of the furnace is $\frac{Q - q}{Q}$, K and $\theta_3 - \theta_4$ must be kept small to make q small. Graphite and electrode furnaces, however, cannot be made indefinitely large, because the last equation shows q to vary directly as the product of L and ρ_2.

In the case of the carborundum furnace, the chief equation may be written—

$$\log. \frac{\rho_2}{\rho_1} = \frac{2\pi L K^1 (\theta_2 - \theta_3)}{Q}.$$

To make the largest amount of carborundum K^1 must be as great as possible, this being effected by having the mixture surrounding the core of high density, for then the crystal mass formed will be also dense. $-\theta_3$ should also be large; but the latter is fixed at a temperature just below that of the formation of carborundum, while θ_2 can only be raised to a point short of its decomposition. As regards the outside of the carborundum cylinder, nothing can be done to diminish k_1, but $\theta_3 - \theta_4$ may be kept small by having a good thickness of raw material always present. Since the value of ρ_2 increases with the length of the run, a point will eventually be reached where $q = Q$ in the efficiency equation; so that a time comes when no more carborundum is made. To work efficiently, the furnace must be stopped long before this happens. The phenomena in Acheson's new furnace for moderately high temperatures are similar to the last, but are more complicated, as a multiplicity of cores is employed.

Charge of Stealing Electricity.—At Marlborough Street, on Saturday, Léon Guerin and Louise Jones, two French restaurant keepers, of Frith Street, Soho, were charged with stealing electricity from the Metropolitan Electric Supply Co. by discon-

necting the wires passing through the meter and connecting them outside the meter with another piece of wire, so that the electricity passed through the wires outside the meter and was not recorded. Guerin had been an electrician on board a ship. The woman was discharged, but the man was committed for trial.

Sub-division of Power by Electricity.—Those who remember the old workmen's houses of the Lancashire woollen district will recollect the upper or attic storey in which weaving was carried on by people in their homes. The system was undoubtedly superior to the factory system, and it was economical enough too in the old hand-loom days. But when steam power was introduced the isolated hand looms could not compete with it, and the factory system grew up. At St. Etienne, in France, where silk is woven, there are no fewer than 8,000 looms at work in the homes of the people. This has been rendered possible by electrical power distribution, the charge for electricity being at the rate of 8s. per loom for 30 days, and a ½-H.P. motor being sufficient to drive two looms. There can be no doubt that electricity will afford many such opportunities in the future. In the metal trades, for example, it would be a very small labour to carry to and fro the stampings of watch parts to be machined at home, and light watch machinery is so easily driven by a small electric motor, that the watch trade seems to offer one of the best openings for home industry.—*American Machinist.*

The Institution of Electrical Engineers and the Tomb of Volta.—The bronze shield subscribed for by the students of the Institution of Electrical Engineers at the beginning of the present year has now been placed upon the tomb of Volta at Camnago, near Como. The ceremony of fixing it in place was performed on Sunday, October 5th, with many expressions of international good feeling, in the presence of Prof. Count Alessandro Volta, Cav. Franchi, the Sindaco of Camnago, with several members of the Volta family, and a number of other guests. The shield is mounted on a slab of green marble supported on granite in front of the tomb. The electrotype reproduction, which was officially deposited on the tomb on the occasion of the visit of the Institution in April last, has been transferred to the Civic Museum in Como, where it is placed in the collection of the Volta relics.

Berlin High-Speed Railway.—The *Times* Berlin correspondent said on 6th inst.:—"It is believed that the experiments on the military line between Marienfelde and Zossen have proved the entire suitability of high-speed electric trains for long railway distances, and it is estimated that with the average speed which is now being attained—175 kilometres per hour—the journey from Berlin to Cologne, a distance of 577 kilometres, could be performed in 3¼ hours, as against the time now taken by the quickest express, which is nine hours. The permanent way, which was specially constructed by the Prussian Ministry of Ways of Communication, is said to have most successfully stood the great strain which was put upon it in to-day's trial. This was formerly the weakest point of the whole enterprise, and it is notorious that on the occasion of some former experiments the line was almost totally ruined. The highest sectional speed attained to-day was between the stations Mahlow and Ringsdorf, a distance of 5 kilometres (3·107 miles), which was covered in 1½ minutes."

Electrocuted in a Coal Mine.—At Airdrie, on Monday, a public inquiry was held into the circumstances attending the electrical accident in a pit at Rosehall Colliery on September 11th. The evidence showed that while two men, Robert Bell and Robert Scrilliton, were walking along the haulage road in the pit they suddenly dropped down dead. Along the shaft and road were carried three electric cables, one for pumping, and the others for signalling purposes, and the theory of several of the witnesses was that the men had, in some way, come in contact with the wires or their surroundings, and received a powerful shock, as there was a strong current on at the time. Mr. Gilbert Scott Ram, electrical expert from the Home Office, gave it as his opinion that some iron tool must have fallen in the shaft and struck the wires, causing the momentary shaking and emission of electric sparks described by the witnesses, and that the deceased had been in contact with the wires at the time. The verdict of the jury was to the effect that the deceased had received a severe electric shock from the electric signal wires on the top "dock" of the electric haulage road, which, in some way not definitely disclosed, had become highly charged with electricity in the pit.

Incandescent Electric Lamps.—An important announcement is made in regard to the prices proposed to be charged by the recently formed syndicate of incandescent electric lamp makers in Europe, which has been constituted as a company in Berlin under the title of the Verkaufs-stelle der Vereinigten Gluhlampen Fabriken. The announcement is that the syndicate has increased the price of lamps to wholesale customers from 3 12d. to 6d. per lamp, or an advance of 48 per cent. This large increase apparently applies to lamps with pear-shaped bulbs of 5, 10, 16, 25 and 32 normal candle-power of German or English standard; and as the syndicate comprises the principal makers in Europe who carry on an export trade, it may be reasonably expected that an advance will soon take place in the prices of the large number of foreign lamps sold in Great Britain. The syndicate includes the Siemens & Halske Co., of Berlin, the Berlin General Electricity Co., the United Electricity Co., of Budapesth, Sturm & Co., of Vienna, and certain Dutch works represented by Herr Phillips, of Amsterdam.

New Technical Institute at Hackney.—On Thursday evening last week the Hackney Technical Institute was opened by Dr. E. Baxter Forman, chairman of the Governors. Dr. Forman delivered a speech in which he quoted in some detail the opinions held by Mr. Balfour, Mr. Chamberlain, Lord Rosebery and other authorities upon the state of British trade and manufacturing, and the backwardness of this country as compared to Germany in the matter of technical education. The opinions expressed in the L.C.C. report on the applications of science to industry were also largely quoted from, among the remarks singled out being those of Prof. Ayrton, who tried to show that English electrical manufacturers were out of the running, and that we lacked scientifically-trained leaders. The Doctor, as well as other later speakers, dwelt upon the necessity for the youth of the land being taught to take life more seriously, paying more real regard to self-improvement and education for commercial and professional callings than to athletics and amusements. Mr. Tom Hosgood, vice-chairman of the Governors, and a man who has rendered a great deal of unselfish service for the good of the locality, explained that the cost of the work carried out so far had been £23,704, but, he said, that was only an instalment; they had very large plans for covering the whole of the available ground. The Institute has been paid for partly by certain moneys from the Sir John Cass charity, partly by private subscriptions from Hackney inhabitants, and from the grants made by the Technical Education Board of the L.C.C. It was to the last-mentioned body that the Governors are looking for a supply of funds in the future. The subjects to be taught include engineering, mathematics, chemistry, biological science, physics, art, &c., and later on commercial languages. The principal of the Institute is Mr. P. R. Kirk, M.A., A.M.I.M.E. He is head of the engineering department, with Mr. P. J Haler, B.Sc., as his lecturer and demonstrator. Principal Kirk is also head of the mathematics section. The physics and electrical engineering is under the control of Dr. Alfred Hay, M.I.E.E. The course of instruction in this department consists of lectures and laboratory work. The more elementary classes cover the syllabuses of the Board of Education and the Matriculation and and Intermediate B.Sc. (Science and Engineering) Examinations of the University of London; the advanced courses are intended for electrical engineers, and engineering students desirous of acquiring a thorough technical knowledge of various branches of electrical engineering, or who are preparing for the final B.Sc. examination of the University of London.

London County Council.—The Council at the meeting on Tuesday, decided to advance to £9,514 to the Battersea Borough Council for electric lighting purposes at the higher rate of interest of 3¾ per cent., which is now to be charged for loans to local authorities.

The Highways Committee reminded the Council of the authority given last July to prepare plans, specifications and estimates of cost for the reconstruction on the conduit system of various sections of the northern tramways, and the construction of certain authorised lines in connection therewith, the total length being 52 miles of single line. It appeared desirable that the work in relation to those sections which could be worked independently with through services of cars, should be put in hand with as little delay as possible. The following lines could be most conveniently dealt with in the first instance:—(1) Theobald's Road terminus *viâ* Clerkenwell Road and Shoreditch to the London Docks; (2) Norton Folgate terminus *viâ* Kingsland Road to Stamford Hill; (3) Aldgate to Poplar; (4) Moorgate Street to Old Street; (5) Holborn to junction with Theobald's Road; and (6) along Old Street between Great Eastern Street and Shoreditch. The first three of these routes are of considerable length, and, in conjunction with the others, form several main tramway routes on which through services could be worked. The length of the lines proposed to be first dealt with is about 22 miles of single line, and it would be practicable for the whole of them to be operated from the Greenwich power station. It was not possible to submit estimates of the cost of the work, as trial holes would have to be made at certain points along the routes in order to determine the depth available for the conduits over railway and canal bridges, and the positions of pipes, wires, and other obstructions under the carriageways, but as soon as the preliminary investigations had been completed, the Highways Committee proposed to report fully on the matter. In the meantime an expenditure of £600 was sanctioned by the Council for the making of trial borings.

The Council approved an estimate of £2,000 for the making of surveys, the digging of trial holes, and the preparation of plans, specifications and estimates for the second portion of the power station to be built at Greenwich. The consideration was postponed of a recommendation to expend £30,500 on the construction of a double line of conduit tramways along St. John's Street and St. John Street Road to join the existing tramways in High Street, Islington.

Personal.—Our congratulations to Mr. Alderman Robb, the chairman of the Tunbridge Wells Electricity Committee, upon his election to be mayor for the ensuing year.

The Postmaster-General has appointed Mr. A. E. W. Codrington to be his private secretary.

Mr. Stephen Sellon has resigned the position of chief engineer to the British Electric Traction Co., in order to devote his time exclusively to private practice, and for this purpose he has opened an office at 36, Victoria Street, Westminster.

A "Doctor" and Electric Belts.—On Tuesday, at Bow Street Police Court, before Mr. Marsham, Lewis Bailles, of 164, Strand (from which address numerous advertisements of the Dr. McLaughlin Electro-Vigour have been published in the newspapers), was summoned for falsely representing himself as being a medical practitioner by using the description of "M.D." Mr. Bodkin, who supported the summonses on behalf of the Medical Defence Union, said that for some time past these advertisements had been appearing in the newspapers, and, no doubt, from the position of such papers, the advertisements gained a certain amount of weight. In every one of those advertisements, which related to the power of a so-called electric belt to cure every known, or unknown, disease from which human beings suffered within the shortest possible time, it was stated that persons might call and see the wonderful appliance, and to remember that "when you use electro-vigour, you are under the care of a qualified physician, who will advise as to the best way to cure your troubles. Consultation and examination free. If you cannot call at our office, we will send you a beautifully illustrated book explaining our method of how you can cure yourself in your own home." The company was also advertised as having branch offices at Manchester, Glasgow, and in various towns in the Colonies and America, whence this thing originated. The advertisements made a particular point of the person calling being under the treatment of a qualified physician; and that came to the notice of the Medical Defence Union. On two different dates two of the clerks to the solicitors of the Defence Union called at 164, Strand. A Mr. Turrell went on July 30th, and upon being shown upstairs to the defendant he asked him whether he was a doctor. The defendant replied that he was, and Mr. Turrell then said he had called on behalf of a friend who was unwell. His symptoms were discussed, and finally the defendant wrote his name on a card, describing himself as "Dr. Bailles." He said that he was an English doctor, that he had four medical qualifications, that he had been a ship's doctor, that he had attended that office for about a year, and that he was the only medical man there. There was a discussion as to the price of the belts; and after some further observations the defendant said that, if a patient wanted medicine, he was in the habit of prescribing drugs. It was then thought right that another clerk should go to the place; and on September 21st a Mr. Whitwell called there. The defendant asked Mr. Whitwell a number of questions as to his symptoms, and examined him with a stethoscope. The defendant pronounced him to be suffering from weakness of the heart and enlarged liver, to cure which one of the belts was recommended. In order to secure Mr. Whitwell's patronage, the belt was offered at the reduced price of £3, but the enormous sum usually asked for them was £10 10s. Mr. Whitwell asked the defendant whether he was Dr. McLaughlin, and he replied, "No; he is in Chicago." He handed Mr. Whitwell a pamphlet which it was no part of his duty to criticise, except to say that it was a pamphlet which, if sent open through the post, would be immediately suppressed, not only for the illustrations, but for the subject-matter. The illustrations were such as ought not to appear except in medical works and under proper medical supervision. At Mr. Whitwell's request, the defendant wrote his name down as follows—"L. Bailles, M.A., M.B., &c." A third clerk was instructed to write to the defendant in answer to one of the company's advertisements, and he was importuned by at least two dozen letters to call and buy these belts, which were offered to him at a very considerable reduction, if only his patronage could be secured. Upon inquiries being made it was found that the Medical Register did not disclose the name of Dr. Bailles. Further investigation, however, showed that up to 1894 there was a Lewis Bailles on the Register, holding the position of bachelor of surgery of the University of Durham and bachelor of medicine at the same University. On July 6th of that year the defendant was convicted before Mr. Justice Grantham of the crime of rape, and sentenced to five years' penal servitude. After serving part of that sentence he was released; and the next that was heard of him was his holding himself out to be a doctor in the way described in these advertisements, the repetition of which should perhaps have first demanded a little more inquiry. Upon the minutes of the General Medical Council it appeared that in 1894, after his conviction, an inquiry was held, and the defendant was then struck off the Register. The whole of his degrees, obtained at Durham University, were also taken from him. The case was a serious one, and he should ask the magistrate to mark his sense of the gravity of the offence by the amount of the fine which he might impose. He also applied for substantial costs, pointing out that the pecuniary results from such extensive advertising could not be other than satisfactory.

Mr. Marsham asked whether there was any suggestion of ill-treatment of any kind, or that the treatment was not beneficial.

Mr. Bodkin replied that he had been given to understand that these belts were so absolutely free from any electricity that they were just as if a person wrapped a piece of paper round the body. They were absolutely worthless.

Mr. Treadwell (for the defendant): Is the learned counsel giving evidence upon that?

Mr. Bodkin: There is no evidence that any actual injury has been caused to any person; but it is not for me to discuss that.

Mr. Treadwell: I am not here to represent the company, and they are not here to explain any pamphlets which have been issued by them. I ask you to dissociate from your mind the defendant's connection with the company.

Mr. Marsham fined the defendant £20 on the first summons and £5 on the second, with £21 costs.

Appointments Vacant.—A lecturer on wiring and technical mathematics, on one evening per week, at South-Western Polytechnic; an assistant for Barnes, at £120; switchboard attendant for Fulham (25s.). See our advertisements to-day.

The Supposed Electrolysis of Water Vapour.—Mr. F. A. Lidbury presented a paper bearing the above title to the general meeting of the American Electro-Chemical Society, which was held at Niagara Falls last September. The paper itself is an account of experiments carried out by Messrs. D. L. Chapman and Lidbury, which have already been published in this country in the *Transactions of the Chemical Society* (1902, lxxxi., 1,301), where the apparatus employed is fully described. Briefly, it may be said that water vapour was drawn by means of Sprengel pumps through a tube fitted with platinum electrodes from a receiver maintained at 25° C. The vapour entered the electrolysis vessel either midway between the electrodes, or near one of them, and it was diverted towards either end of the tube, which it quitted for receivers packed with ice or freezing mixtures. The products were then exploded to remove equivalent quantities of hydrogen and oxygen, and the residual gases were examined. A voltameter and an air-gap were placed in series with the electrodes. In some tests, where the vapour entered the centre of the reaction tube, the volume of hydrogen recovered from the cathode end thereof ranged from 1·07 to 2·41 times that liberated in the voltameter. When the vapour entered near the cathode, the corresponding ratios were from 3·41 to 7·31; but when the inlet was close to the anode, the amount of residual gas was less than before, that from the anode being hydrogen, and that from the cathode oxygen. Mr. Lidbury concludes that in the partial decomposition of water vapour by the electric discharge the hydrogen and oxygen liberated tend to separate and take up different positions in the tube, the hydrogen collecting at both anode and cathode, and the oxygen in the middle of the tube. Perrot's old experiments, therefore, only rendered it presumable that the electrolytic decomposition of water in the state of vapour should be analogous to that of the liquid, because of the particular conditions he employed—at any rate, the larger production of gases in the spark tube than in the voltameter necessitates a modification in the theory. At present the mechanism of the separation of hydrogen and oxygen derived from vaporised water must remain an open question.

The Electrolysis of Water.—Messrs. J. W. Richards and W. S. Landis presented a paper to the last meeting of the American Electro-chemical Society, upon the application of Ohm's law to dilute sulphuric acid for voltages up to 3·5. To obtain the necessary high resistance, their cell consisted of a pair of electrode-vessels joined together by means of a calibrated capillary tube, whose bore was uniform and its area known, and whose length could be varied as might be necessary. Reason was found to believe that there is a relationship between the current used and the size of the electrodes, but this matter was not investigated. There seemed to be a certain minimum size for the electrodes in order that the products of decomposition might re-combine as rapidly as formed. The tests were carried out upon 0·1, 1·00, 10·00, and 30·00 per cent. sulphuric acid, and the results are plotted in curves alongside Kohlrausch's values for the conductivity of the several electrolytes. From five to eight experiments were made with each acid at different voltages, the resistances being then averaged. The mean calculated values for the four acids above-mentioned came out at 202·7, 22·05, 2·74, and 1·354; Kohlrausch's specific resistances being 196·9, 21·93, 2·56, and 1·358 respectively. A similar experiment with centinormal (0.053 per cent) sodium carbonate solution gave a mean specific resistance of 1,275 ohms—Kohlrausch's figure being 1,047·7—the latter is possibly at fault. Neglecting the sodium carbonate, the curves show a satisfactory agreement with theory, that referring to 30 per cent. acid, which has maximum conductivity, being extremely close.

Knight v. the Isle of Wight Electric Light and Power Co., Ltd.—In the Vacation Court on Wednesday, before Mr. Justice Bucknill, this case came on for hearing on a motion to restrain the defendants from causing a nuisance by reason of noise, smell and vibration. After some discussion it was arranged that the motion should stand over until the second motion day in next sittings, the defendants in the meantime giving an undertaking to remedy as soon as possible any just cause of complaint.

Grantham Electricity Works.—The ceremony of formally opening the Grantham electricity works was performed on Monday by the Mayor (Mr. W. Hornsby, J.P., D.L.). Mr. W. H. Milnes (chief engineer at the works) at the outset explained that though they had had the station open for some months, that was the official inauguration. Mr. Milnes gave a description of the works. They had anticipated, he said, having about 6,000 lamps connected up at the end of the year, but already they had no fewer than 15,000 applied for, and that necessitated increasing the plant.

THE CENTRAL STATION ENGINEER.

The successful candidate for the post of senior charge engineer at the Taunton Corporation Electricity Works was H. E. Sharp, from Bristol Electricity Works.

Mr. Sydney H. Barber was presented last week with a silver cigarette case and match box on the occasion of his relinquishing the chief assistantship at the Shipley Electricity Works, to join the outside staff of Messrs. W. T. Glover & Co.

At the Brighton Corporation Electricity Works last week Mr. W. E. White, one of the staff, was presented by Mr. J. Christie, the resident engineer, on behalf of the employés, with a useful set of Sheffield cutlery, on the occasion of his marriage. Mr. White was asked to accept a purse on behalf of his wife.

Mr. W. H. Alabaster, of the Salford Corporation Electricity Works, has been appointed chief assistant electrical engineer to the City of Melbourne, Victoria.

The staff of the Reading Electric Supply Co., Ltd., held their fourth annual supper and smoking concert on Wednesday of last week at Rivernook, de Montfort Island, Reading, by kind permission of Mr. Arthur T. Cooper (the managing engineer). After an excellent supper—to which every one did justice—came the concert, which was contributed to by Messrs. A. T. Cooper, W. Burr, Coombs, Hayward, Day, Nobes, Russell, Phillips, Filmore, Harrison, Folland and Brooks. During the evening, Mr. Cooper, in a few well-chosen remarks, presented Mr. W. J. Fisher, the head clerk, with a marble clock, on the occasion of his marriage, and Mr. D. H. Coombs (who is leaving to take up the position of resident engineer to the Whitchurch and Pangbourne Electric Supply Co., Ltd.) with an oak book cabinet. A most enjoyable evening was brought to a conclusion with musical honours, and a hearty vote of thanks to Mr. and Mrs. A. T. Cooper.

NEW COMPANIES REGISTERED.

Municipal Foundry and Engineering Co., Ltd. (78727).—This company was registered on October 6th, with a capital of £5,000 in £1 shares (1,000 preference, 1,500 "A" and 2,500 ordinary), to adopt an agreement between C. Hall and J. H. Bardsley, and to carry on the business of iron-founders, mechanical, electrical, chemical and general engineers and contractors, electricians, suppliers of electricity, manufacturers of electrical apparatus, manufacturers, producers and suppliers of light, heat, sound and power, by electricity, galvanism, magnetism or otherwise, &c. The first subscribers (each with one share) are:—C. H. Boardman, 41, John Dalton Street, Manchester, solicitor; J. H. Bardsley, 60, King Street, Manchester, chartered accountant; J. H. Pontefract, "Woodville," Farm Road, Stockport, cashier; T. Chadwick, 76, Princess Road, Moss Side, Manchester, clerk; H. M. Styler, 10, Slade Lane, Longsight, Manchester, clerk; E. W. McBride, 54, Bishop Street, Moss Side, Manchester, clerk; and W. Dearden, 60, King Street, Manchester, chartered accountant. No initial public issue. The number of directors is not to be less than three nor more than five: the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company. J. H. Bardsley has power to appoint another director, who need not be a shareholder.

Blake-Morscher Electrical Ore Separator Syndicate, Ltd. (78,722).—This company was registered on October 6th, with a capital of £10,000 in £200 shares, to adopt an agreement with H. C. Callahan, to investigate the validity of the patents and the efficiency of the process and mechanism therein referred to, to promote a company for the purpose of acquiring all or any of the property and liabilities of this company or otherwise, and to carry on the business indicated by the title. The first subscribers (each with one share) are:—H. C. Callahan, Hotel Cecil, W.C., mining engineer; J. E. Scantlebury, 48, Threadneedle Street, E.C., mining engineer; A. E. Weinberg, 3, Buckingham Gate, S.W., mining engineer; T. L. M. Llewellyn, 24, Austin Friars, E.C., stockbroker; W. H. Dove, 24, Austin Friars, E.C., stockbroker; C. J. Dawson, 9, Greenhill Road, Harlesden, N.W., shorthand writer; G. I. Hakewell, Cotterbury, Garden Road, Bromley, secretary; L. Robinson, 24, Throgmorton Street, E.C., stockbroker; and W. Clark (by his attorney, L. Robinson), Carrick Grange, Sevenoaks, gentleman. No initial public issue. The number of directors is not to be less than three nor more than five; the first are H. C. Callahan, E. A. Weinberg, J. E. Scantlebury, and T. L. M. Llewellyn. Registered office, 20, Copthall Avenue, E.C.

Hemsworth Electricity Supply Co., Ltd. (78,733).—This company was registered on October 7th, with a capital of £6,000 in £1 shares, to acquire from the Rev. C. Leteux and G. Hodgson the benefit of a certain contract entered into by them (as trustees for this company) with R. J. Nicholson, and to carry on the business of electrical or mechanical engineers, founders, finishers, tin smiths, metal merchants, suppliers of electricity for light and power, &c. The first subscribers are:—R. J. Nicholson, 26, Cannon Street, Manchester, engineer, 25 shares; E. A. Wales, Hemsworth, photographer, 5 shares; J. Gomersall, Hemsworth, 25 shares; J. W. Gibson, Kirksmeaton, near Pontefract, innkeeper, 5 shares; C. E. Turner, Hemsworth, printer, 25 shares; Rev. C. Leteux, Hemsworth, 25 shares; and M. R. McClure, Morris Bank House, Stockport, engineer, one share. Minimum cash subscription, 1,000 shares. The number of directors is not to be less than three nor more than seven; the first are Rev. C. Leteux, J. Gomersall, C. E. Turner, R. J. Nicholson (managing director), and two others to be appointed by the company; qualification, £25; remuneration (except managing director) as fixed by the company. Registered office, 5, Bank Street, Hemsworth, near Wakefield, Yorks.

Seale, Austen & Barnes, Ltd. (78,734).—This company was registered on October 6th, with a capital of £15,000 in £1 shares, to acquire as going concerns (1) the business of ironmongers now carried on at Tonbridge by H. Seale and J. C. Austen as "Seale & Austen"; (2) the business of electrical engineers and dealers in electrical fittings and machinery carried on at Tonbridge by H. Seale, J. C. Austen and L. E. Bowden, also as "Seale & Austen"; and (3) the business of builders and general ironmongers, smiths and oil and colour merchants, carried on at Tonbridge by W. Barnes, A. C. Barnes and H. C. Barnes, as "Case & Barnes," and to carry on the said businesses and any other incidental or auxiliary thereto. The first subscribers are:—J. Lees, 4, The Terrace, Tonbridge, water works manager, with 50 shares; W. Batchelor, 17, Lavender Hill, Tonbridge, clerk, with 50 shares; F. H. Spanner, 28A, Hadlow Road, Tonbridge, clerk, with one share each; W. N. Neve, Cornwall House, Tonbridge, clerk, with five shares; F. S. D. Neve, 1, Bank Street, Tonbridge, auctioneer, with 50 shares; R. H. Hollands, 18, St. Mary's Road, Tonbridge, secretary, with 10 shares; and H. W. Peach, 55, Pembury Road, Tonbridge, solicitor, with 10 shares. No initial public issue. The number of directors is not to be less than four nor more than seven: the first are J. Lees, W. Batchelor, F. H. Spanner, W. N. Neve, F. S. D. Neve, R. H. Hollands and H. W. Peach. On completion of purchase agreement, H. Seale, J. C. Austen (managing director), W. Barnes and A. C. Barnes, shall become directors; qualification, £400; remuneration, one guinea each per board meeting attended.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Newcastle and District Electric Lighting Co., Ltd. (28,022).—Issue on September 9th of £11,085 debentures, part of series created January 30th, 1893, to secure an amount not exceeding half the company's paid up capital. Property charged:—The company's undertaking and property, present and future, except uncalled and unpaid capital. No trustees. Previously issued of same series, £50,000.

Woodhouse and Mitchell, Ltd., electrical and general engineers, Brighouse (74,964).—Issue on September 11th of £2,800 debentures, part of series created March 18th, 1903, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £1,000.

Geneva Tramways Co., Ltd. (72,081).—A trust deed dated August 26th, 1903, to secure £20,000 5 per cent. debentures created by resolution of August 20th, ranking in priority to original debentures for £850,000, have been registered. Property charged:—49,910 shares of 100 fr. each, 30,000 shares of 500 fr. each, and 12,000 founders' certificates in La Compagnie Genevoise des Tramways Electriques, and any other property for the time being representing the same or attributable thereto. Trustees: London Trust Co., Ltd., 37, Lombard Street, E.C.

Anglo-Portuguese Telephone Co., Ltd. (24,545).—Issue on September 14th of £3,000 second debentures, part of series created March 21st, 1890, to secure £40,000, charged on the company's undertaking and property, present and future, subject to prior debentures for £10,000. No trustees. Previously issued of same series: £17,600.

Eastern Telegraph Co., Ltd. (6,338 C).—Issue, on September 25th, of £10,000 debenture stock, being the whole of series created September 23rd, 1903. Property charged: The company's undertaking and revenue. Holder: F. R. de Levanté, 141, Hill Street, Peckham, S.E. Debenture stock previously issued: £1,839,120.

Buenos Ayres Electric Tramways Co. (1901), Ltd. (71,206).—An acknowledgment of indebtedness, dated September 8th, 1903, to secure £15,000 debenture stock, ranking *pari passu* with £185,000 debenture stock previously issued under a trust deed dated June 8th, 1903 (completing total authorised issue of £200,000), has been registered. Property charged (specifically): Certain tramway concessions, freehold land, and other property and rights. (As a floating security): The company's undertaking and property, present and future, including uncalled capital. Trustees: W. Greenwell, 2, Finch Lane, E.C.; F. C. Tiarks, 145, Leadenhall Street, E.C.; and T. C. White, Bank Chambers, 2, Cockspur Street, W.

Newmarket Electric Light Co., Ltd. (44,450).—Issue, on September 21st, of £300 first mortgage debentures, part of series created October 16th, 1899, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees, G. H. Verrall, Newmarket; and F. E. Gripper, Broad Sanctuary Chambers, Westminster. Previously issued of same series: £13,100.

Ingleton Electric Lighting and Power Co., Ltd. (60,796).—This company's annual return, made up to March 30th, was filed on August 11th. The capital is £4,000 in £1 shares, 3,175 of which have been taken up and paid for in full. Mortgages and charges: £2,600.

Metals Corporation, Ltd. (70,569).—This company's annual return was filed on October 5th, when 17,007 shares had been taken up out of a nominal capital of £25,000 in £1 shares. £1 per share has been called up on 2,007 shares, resulting in the receipt of £2,000; £7 remains in arrears; £15,000 is considered as paid on £15,000 shares; no mortgages or charges.

ELECTRIC TRAMWAY ACCOUNTS.

Hull and Glasgow Municipal Tramways.

The Hull Tramways Department has somewhat improved on the excellent results of last year. About a mile of route has been added, and 75,000 more car-miles run; the average receipts and operating expenses are both rather higher than last year, although the percentage of working expenses to gross receipts is reduced. The progress of the undertaking since the electrification will be gathered from the following figures:—

Period ending.	Miles of route open.	Passengers carried.	Average receipts from fares per car-mile.	Percentage working expenses to gross receipts.	Car-mileage.
1900 ...	4	6,218,971	10·85d.	39 72	573,420
1901 ...	10	17,264,013	10·48d.	44·44	1,647,026
1902 ...	10	21,065,999	9·49d.	53 42	2,218,696
1903 ...	11	22,062,703	9·57d.	52·56	2,293,282

The Glasgow tramways department has added some 13 miles of route to its system during the past year, and still retains its lead on Liverpool for first position. The progress of this undertaking during the last eight years will be gathered from the following table:—

Period (to May 31st)	Average cars and 'buses. (16-hour day.)	Lines open for traffic as at May 31st (measured as single track).	Mileage.	Passengers carried.	Receipts.	Average per mile.
1898-1899	305·85	81¼	9,071,640	118,775,668	£433,128	11·46d.
1899-1900	316·96	83¾	9,657,429	127,628,484	£464,787	11·55d.
1900-1901	322·02	88	9,847,545	132,557,724	£484,873	11·92d.
1901-1902	365·41	103½	12,615,021	163,678,190	£612,826	11·66d.
1902-1903	399·58	130	14,008,750	177,179,549	£653,300	11·19d.

Both undertakings possess their own power plants, the Glasgow plant comprising some 11,200 kw., and the Hull one, 1,200 kw. Mr. W. J. McCombe is the tramways manager, and Mr. J. Wilkinson the engineer at the latter city. Mr. John Young is the general manager for the Glasgow undertaking.

Analysis of Working Expenses per Car-Mile.

—	Hull.	Glasgow.	
Year ending	1903.	1902.	1903.
Traffic expenses, including wages of employés, car-shed expenses, tickets and uniforms	2·16d.	3·20d.	3·02d.
Electrical energy	·77d.	·41d.	·35d.
Management and general expenses, including salaries, printing, stationery, insurance, law and sundry ...	·32d.	·42d.	·39d.
Rent, rates and taxes	·71d.	·45d.	·36d.
Repairs and Maintenance.			
Track	·11d.	·28d.	·36d.
Overhead equipment	·12d.	·10d.	·10d.
Rolling stock	·81d.	·33d.	·47d.
Generating plant	·10d.	·02d.	·06d.
Buildings, workshop and sundry	·03d.	·09d.	·10d.
Total working expenses ...	5·13d.	5·30d.	5·21d.
Percentage of working expenses to receipts, 1903	52·56 %	46·35 %	

The working expenses are in both cases, among the lowest in the kingdom; in the case of Hull, the higher power costs, amounting to ·77d. per car-mile compared with ·35d. at Glasgow, place the former town at a disadvantage. The outputs in the two cases are two and thirteen million units respectively. In the case of both the above cities, the tramways departments supplied the lighting departments with energy during the past winter, Hull supplying 46,193, and Glasgow 150,000 units.

General Statement.

—	Hull.	Glasgow.
For 12 months ending ...	March, 1903	May, 1903
Length of route	11	68
Total length of track ...	22	129
Number of cars in use ...	64	399·6
Car-miles run	2,293,282	14,008,750
Passengers carried per annum	22,062,703	177,179,549
Capital expenditure to date	£310,551	£2,754,855
Traffic receipts	£91,492	£653,200
Total receipts	£92,343	£656,572
Working expenses	£48,939	£304,315
Gross profit	£43,404	£352,257
Income per car-mile	9·65d.	11·25d.
Working expenses per car-mile	5·13d.	5·21d.
Interest and sinking fund per car-mile	1·91d.	1·87d.
Total expenses per car-mile ..	7·04d.	7·08d.
Profit or loss	2·77d.	4·17d.
Cost of energy per car-mile...	·86d.	·35d.
Average fare per passenger ...	1·00d.	·88d.
,, charged per mile	—	·45d.
Revenue per mile of route ...	£8,395	£9,655
Expenditure per mile of route	£4,449	£4,475
Total number of units used ...	2,057,215	13,168,975
Units used per car-mile ...	90	·94

The above comparison reflects very creditably on the results achieved by the Hull undertaking, which are perhaps better than those of Glasgow, with its far greater possibilities, and a record of efficient working in previous years.

Profit Statements.

	Hull.	Glasgow.
To interest on loans	£9,083	£1,072
To sinking fund	9,147	43,294
To Govan and Ibrox Tramways, interest and sinking fund ...	—	£5,959
To balance on year's working ...	25,174	242,832
Gross profit ...	£43,404	£352,257

After meeting working expenses the Hull department earned a gross profit of £43,404, and a sum of £13,000, being the balance from 1902, was brought forward in addition. The latter sum was subsequently allocated to the relief of the rates; financial charges absorbed £18,230; a sum of £10,674 was added to the reserve fund, bringing it up to £36,573, and leaving a balance of £14,500 in hand. Let us hope the department will crown a successful year by creating a much-needed depreciation fund.

For purposes of comparison, the Glasgow statement of accounts is rearranged. After meeting actual working expenses and financial charges, a sum of £242,832 remains. Out of this the department allocates for permanent way renewal, £450 per mile of single track, or £53,516; to depreciation of equipment, buildings, &c., a sum of £74,039; also a further sum of £65,000 in writing down various items in the capital expenditure account which are considered too high; making a total of £192,555, or 7 per cent. on the capital expended, for depreciation and track renewals. Payments to the common good absorb £25,000, and £25,277 is added to the general reserve fund which, however, owing to withdrawals, only amounts to £21,134.

ELECTRICITY SUPPLY ACCOUNTS.

King's Lynn Corporation Electric Supply.

The returns of the Lynn electrical undertaking show considerable improvement over those of last year. The year's working has resulted in a deficit of only £48 as compared with £790 in the previous year, and, if the present rate of increase in output is maintained, a balance on the right side is within measurable distance.

The department is cultivating a power load and some 25 motors of 109 H.P. are connected.

The prices charged are: for private lighting, 5d. and 4¾d. per unit on a flat rate; power, 3d. for the first hour per day and 1½d. per unit after. The plant consists of a combined gas and steam generating station, the later additions being steam. The electrical engineer is Mr. J. Pilling.

General Statement.

For year ending March 31st—	1902.	1903.	Inc.
Total capital expended ...	£43,434	£45,081	£1,647
Number of units generated—			
Private lighting	93,274	117,499	24,225
Motors	—	25,715	—
Public lighting	193,405	179,961	—13,444
Total	286,679	323,175	36,496
Equiv. No. of 8-c.p. lamps connected	14,220	17,482	3,262
Number of public lamps ...	452 pairs inc. 22 arc.	448 pairs inc. 19 Nernst 22 arc.	—
Maximum load in KW.	210	250	40
Revenue Account—			
Gross revenue	£4,220	£5,690	£1,470
,, expenditure	£2,335	£2,826	£511
,, profit	£1,885	£2,864	£979
Average price per unit obtained—			
Private lighting	4·76d.	4·89d.	·13d.
Public ,, ...	2·06d.	2·32d.	·26d.

Revenue Account.

1903.	Gross.	Per unit.
Sale of energy	£4,630	3·44d.
Meter rents...	128	·09d.
Sale and repairs of lamps...	932	·69d.
Gross revenue	£5,690	4·22d.

Working Expenses.

Year ending March 31st—	1903. Gross.	1903. Per unit.	1902. Per unit.
Coal and other fuel	£636	·47d.	·59d.
Oil, waste, water and engine room stores	35	·03d.	·09d.
Wages incurred in generation and distribution	508	·38d.	·44d.
Repairs and maintenance of machinery, plant, and buildings ...	209	·15d.	·14d.
Works and distribution costs ...	£1,388	1·03d.	1·26d.
Street lamps, attendance, and renewals	228	·17d.	·21d.
Rent, rates and taxes	179	·13d.	·14d.
Management expenses, salaries of engineers, and clerical staff, general establishment charges, stationery, printing, and insurance	394	·29d.	·34d.
Works costs	£2,189	1·62d.	1·95d.

As a result of the decreased working expenses and improved revenue, the department earned a gross profit of £2,864, which was, however, insufficient to meet the financial charges by the sum of £48, which, added to previous amounts, makes a total deficit of £2,024.

Profit Statement.

To interest on loans	£1,332
,, sinking fund	1,580
Debit balance on year's working	—48
Gross profit	£2,864

CITY NOTES.

Electrolytic Alkali Co.

The annual meeting was held at Liverpool on 8th inst. Mr. C. C. Connor, who presided, said the smallness of profit for the past year was accounted for by the conflict between foreign and English manufacturers of bleaching powder, resulting in a great depression of prices. He regretted, says a financial contemporary, that the results shown were not more satisfactory. The results, on the other hand, did not show any loss of capital, and on that circumstance they must be congratulated, considering the state of business. The small profit made was due to causes over which the directors had no control. From the beginning of the current year, and probably during the greater part of last December, they had very low prices for their bleaching powder in the market. The price which ruled now was probably below the cost of production, and, therefore, there were very good reasons for anticipating a rise in price. So far as the company was concerned, the directors were taking every precaution in establishing improvements, pointing to greater economy in production, and even if prices should not rise, they should certainly not lose any money, and in all probability they would show a better profit next year.

The report was adopted.

It was also resolved that the vacancies on the directorate caused by the retirement of Messrs. J. A. Morice and William Thomson be not filled, and that the number of directors be reduced to six.

South Lancashire Electric Traction and Power Co.

A meeting of stockholders was held at Liverpool on Wednesday last week to consider the scheme, for the reconstruction of the capital of the company, which had been submitted by the board. The scheme proposes that the present 4½ per cent. first mortgage debenture stock shall be converted into 5½ per cent. second mortgage debenture stock, each holder receiving as a bonus an amount of fully paid up ordinary shares in the company equal to 20 per cent. of his holding in debenture stock, and a new terminable first mortgage debenture stock to be issued under the borrowing powers of the company to provide money for continuing the construction of the tramways; the issue of each class of debenture stock to be limited to £600,000, and no borrowed capital beyond these limits to rank in priority to, or *pari passu* with, the proposed second mortgage debenture stock, without the consent of the holders, given by extraordinary resolution passed at a general meeting of such holders.

The resolutions were adopted.

Cuba Submarine Telegraph Co.

The directors' report for the half-year ending June 30th, 1903, to be presented at the meeting on October 21st, says that the total receipts of the six months were £19,325 17s. 11d., while the expenses amounted to £6,066 8s. 4d., leaving a balance of £13,259 9s. 7d., to which has to be added £6,477 18s. 8d. brought forward from last account, giving a total of £19,737 8s. 3d. to be dealt with. The sum of £5,000 has been added to the reserve fund, which now stands at £150,000. The dividend on the preference shares will absorb £3,000, and leave £11,737 8s. 3d., out of which the directors recommend the payment of a dividend at the rate of 5 per cent. per annum and a bonus of 2s. per share on the ordinary shares, both free of income-tax; the balance, £6,137 8s. 3d., being carried forward to the current half-year. The cables have continued in good working order since the date of the last report, with the exception of the Casilda-Tunas section, which was interrupted for a short time owing to damage by a ship's anchor. The company's claim against the United States Government for reimbursement of the cost of repairing the cables cut during the Spanish-American war is still unsettled, but the board are hopeful that His Majesty's representative at Washington will, before long, obtain a satisfactory settlement. The matter of the payment of the subsidy of £2,000 per annum in respect of the coast cables, with the arrears from January, 1899, is still under the consideration of the Cuban Government, and a favourable settlement is expected.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—London United Tramways (1901), Ltd.—Further issue of £206,000 4 per cent. first mortgage debenture stock. The Committee has appointed a special settling day as under:—Wednesday, October 21st: Oriental Telephone and Electric Co., Ltd.—50,000 6 per cent. cumulative preference shares of £1 each, Nos. 1 to 50,000, and has ordered same to be quoted in the Official List.

Indo-European Telegraph Co. — The board have declared an interim dividend for the half-year ended June 30th last at the rate of 5 per cent. per annum, free of income-tax.

STOCKS AND SHARES.

Wednesday Evening.

Stock Exchange paradoxes, like the poor, are always with us, but it is not often that so curious a contradiction exists as may now be seen between the state of the money market and that of business in the House. All talk of a 5 per cent. Bank rate has hushed, and in spite of a particularly harassing settlement, the Stock Exchange is finding surplus cash a positive drug in the markets. But—and here the paradox appears—business is no more stimulated by this supply than are prices. The latter move up a little one day only to be depressed the next, and the torrent of liquidation that has formed a feature during the past week did not leave the electrical departments untouched. In the numerous instances throughout our lists where quotations are officially unchanged on balance, it is mostly very difficult to sell shares at anything over the lowest-mentioned price, whereas in the ordinary way, of course, those who want to realise expect to get something better than that. The present are excellent markets in which to buy, but to those who wish to sell conditions are far from satisfactory, and we should be sorry to advise sales just now. On the contrary, Electricity Supply shares of the best class may be considered decidedly cheap, and a selection from this list will turn out well in the near future, without a doubt.

Of the more active shares, both the Brompton and Kensington varieties are dull, the Preference more especially, and City of London Ordinary have lost ¼, being about as vulnerable an electrical share as can be found in regard to outside influences. South Londons are 10s. easier, losing not only their ¼ improvement of last week, but a further similar fraction into the bargain. "Jimmies" remain dull, and there are a few falls in the prior charges. County 4½ per cent. Debenture shows the principal loss, being 2 points down. The only variation of the monotony of dulness is furnished by Charing Cross and Strand Ordinary, which at 9¼ have recovered the fraction lost a week ago.

To show how good a field for securing profitable investments is now presented by the supply section, a few examples of the yields obtainable upon the shares may be of interest. Charing Cross Ordinary pay the purchaser 5¼ per cent. on his money, Westminsters 4¼, City of London and County of London both nearly 4⅜, and St. James's a little less. Metropolitans pay about 3$\frac{15}{16}$ per cent., Edmundsons a round 5, and Bromptons 3⅝. From these figures, reckoned at the present low prices of the shares, it will be observed that at least 4½ per cent. is obtainable upon investments as sound as may be found amongst industrial undertakings.

Telegraph stocks and shares have suffered very slightly from the surrounding slump. A sarcastic member of the market said he considered the attempt to lay the responsibility of the awful weather at the door of Signor Marconi was a subtle point in favour of telegraph securities. Not even the hampering of the companies by the storms and gales of the past week or so has been used as an excuse for depressing prices in this department, and the only quotable decline is one of ¼ in the speculative Anglo "A" stock. This fall is more than balanced by an advance of 10s. in Cuba Telegraph shares. It's an ill wind that profits nobody, and some people profess that the unsettlement produced by the fiscal controversy should benefit telegraph investments by keeping the wires actively employed upon political speeches and comments thereon, which are of world-wide interest at the present time. British Insulated shares mark a small fall.

The telephone issues are again weaker, and the drop in National Deferred has proceeded another pair of points. It is feared that the gales may have severely injured some of the company's lines, but this maleficence would probably not be thought about in more normal times. Orientals shed $\frac{1}{16}$ upon the attempted sale of a few shares in a restricted market.

City and South London Ordinary is down to 55, a fall of 2 per cent.; no support being accorded to the stock, which at the present quotation will pay £5 13s. to the buyer upon the basis of the dividends of the last two half-years. Central Londons are unaltered, but Metropolitans and Districts continue weak. British Electric Traction Preference have given way 5s., and the Debenture stock at 121½ is 2 down, although there have been several buyers about during the last day or two. The Ordinary are being pressed for sale, and have lost 10s. London United Tramways Preference are steady at 11⅞, and Metropolitan Electric Tramway Preference are ⅞ to 1. British Columbia Electric Railway issues receive a little attention, and the prices continue to gradually harden. The Deferred and Preferred stocks stand at 84½ and 93½ respectively, while the 5 per cent. Preference shares are 10¼, and the 4½ per cent. First Mortgage Debentures, of £40 each, command a premium of £5 per cent.

Amongst miscellaneous shares, British Westinghouse Preference have improved to 5½, Willans & Robinson are 6, and Babcock and Wilcox shares 2⅞. There is no change to report in the prices of manufacturing shares quoted on the succeeding pages.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Oct. 7th.	Closing Quotations Oct. 14th.	Business done week ended Oct. 14th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3⅛	2¼— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3⅛%	6l8.	60/6	45 — 48	45 — 48	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	91 — 93	93	91
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	7⅛— 8	7⅛— 7⅜	7⅜	7⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	145 —155 xd	145 —155	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93 xd	90 — 93	..	..
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7 — 8	7⅛— 8⅛	8⅛	..
6,000	Do. 10 % Pref.	10	..	..	..	16½— 17½	16½— 17½	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½ xd	2½— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8 xd	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —102 %	98 —102 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10¼— 10¾	10¼— 10¾	10⅜	10 7/16
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	124 —129	126	124½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	90 — 93	90 — 93	91⅜	90½
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	107½	106½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11⅜— 12½	11⅜— 12½	12 1/16	11⅜
820,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103 %	100 —103 %	..	..
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	..	8⅜— 9⅛	8⅜— 9⅛	9	8¾
180,042	Do. do. 6 % Pref.	10	..	..	..	12⅝— 13⅜	12⅝— 13⅜	..	..
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22½— 23½	22½— 23½	22½	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	37 — 40	37 — 40	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	98 —102	98 —102	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	99 —101	99 —101	100½	99
1,966,667	Do. do. Def. Stock	100	..	..	4½%	74 — 76	72 — 74	75½	72
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	..	..
900,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	93 — 95	93 — 95	93¼	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102⅜	101⅜
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	1 1/16— 1 3/16	1— 1 1/16	1 1/16	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6¾— 7⅛	6¾— 7⅛	..	..
8,808	Submarine Cables Trust	Cert.	..	..	..	116 —121	116 —121	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5⅛— 6	5⅛— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞— 5⅛	4⅞— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,600	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,990	Western Telegraph, Ltd., Nos. 1 to 207,990	10	7 %	7 %	..	12 — 12½	12 — 12½	12⅛	12 1/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	100	..
88,231	West India and Panama Telegraph	10	2½%	..	..	7/16— 9/16	7/16— 9/16	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	5/8— 11/16	5/8— 11/16	6	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3½— 4½	3½— 4½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	98 —101	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	83 — 87	83 — 87	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	12½— 12⅞	11⅞— 12⅛	12 5/16	12⅛
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11½— 12	11½— 11⅞	11⅞	11⅝
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	120 —123	122	120½
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6½— 7	6 — 6½	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	10 %	5½— 5⅞	5½— 5⅞	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	103 —106	104½	103¾
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	9/16— 11/16	9/16— 11/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	5 %	Nil	Nil	¾— 1⅛	¾— 1⅛	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1 — 1⅛	1 — 1⅛	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
85,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11½— 12½	11½— 12½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5¼	5⅛	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	94 — 97	94 — 97	95½	..
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	99 —102	99 —102	..	..
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	99 —102	99 —102	..	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	56 — 58	54 — 56	57½	56
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	5 %	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	100 —104	100 —104	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1½— 2½	1½— 2½	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81 xd	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1½— 1⅝	1½— 1⅝	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2½— 3	2½— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½— 10	9½— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	97 —100 xd	96 — 99	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	14⅝	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛	5 — 5⅛	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	10 %	18½— 19½	18½— 19½	18½	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	4⅜— 5	4⅜— 5	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 10¾	10½— 10¾	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	34 — 37	34 — 37	36	34½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	93— 96	93 — 96	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring ⅜—½.

Oldham, Ashton and Hyde Electric (£10 pd.), Ord., 14¼—14⅝.
Do. do. Pref. £10 pd.), 10—10⅜.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Oct. 7th.	Closing Quotations Oct. 14th.	Business done week ended Oct. 14th, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡	..	..	..	⅝— ¾	⅝— ¾	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	1	..	..	..	116 —119 xd	116 —119	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	100	..	..	..	10⅜ — 11	10½ — 10⅝	10⅝	..
20,000	Do. do. 7 % Cum. Pref. ..	5	6 %	8 %	8 %	10¼ — 10⅜	9½ — 10¼	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	8⅜ — 9¼	9 — 9¼	..	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5¼ — 5⅜	5⅛ — 5⅜	5⅜	5⅛
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅜ — 5	4⅜ — 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	104	..
44,486	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	5¾ — 6	5¾ — 6	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —111	108 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10½ — 11	10½ — 10⅝	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	..	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	104	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7¾ — 8¼	7⅞ — 8¼	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11⅝ — 12¼	11⅝ — 12¼	12	..
400,000£	Do. do. 4½% Deb. Stock	..	..	..	..	109 —112	107 —110	109½	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —104	101 —104	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6¼ — 7	6⅛ — 6⅜	6 7/16	6½
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6⅛ — 6⅜	6⅛ — 6⅜	6⅜	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —109	105 —108	106	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10¾ — 11½	10½ — 11½	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	101 —104 xd	101 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅛	5
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —102	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	17⅛ — 18⅜	17⅛ — 18¼	17⅜	..
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	.. — ..	3⅛ — 3⅜	..	..
290,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —114	110 —114	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½% π	14½%	14½ — 15½	14½ — 15½	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	97 —100	97	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3½	3 — 3½	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¾%	3⅜ — 4¼	3½ — 3⅝	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4⅞ — 5⅛ xd	4⅞ — 5⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅜ — 5 xd	4⅜ — 5	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12¼ — 13½	12¼ — 13½	13 3/8	13 3/16
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6½	6 1/16	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS. Wednesday, October 14th.

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric .. .. .. per cwt.		5/-	..
a ,, Nitric .. .. per cwt.		22/-	..
a ,, Oxalic .. .. per cwt.		32/-	..
a ,, Sulphuric .. .. .. per cwt.		5/6	..
a Ammoniac, Sal .. .. .. per cwt.		42/-	..
a Ammonia, Muriate (crystal) .. per ton		£33 10	..
a ,, ,, ... per ton		£30	..
a Bleaching powder .. .. .. per ton		£4 10	..
a Bisulphide of Carbon .. .. per ton		£15	..
a Borax .. .. per ton		£13	..
a Benzole (90 %) .. .. .. per gal.		7/-	..
a ,, (50/90 %) .. .. .. per gal.		5/6	..
a Copper Sulphate .. .. .. per ton		£20	..
a Lead, Nitrate .. .. .. per ton		£24	..
a ,, White Sugar .. .. .. per ton		£31	..
a ,, Peroxide .. .. .. per ton		£27 10	..
a Methylated Spirit .. .. .. per gal.		2/6	..
a Naphtha, Solvent (90% at 160° C). per gal.		5/6	..
a Potash, Bichromate, in casks .. per lb.		8d.	..
a ,, Caustic (75/80%) .. .. per ton		£24	..
a ,, Bisulphate .. .. per ton		£35	..
a Shellac .. .. per cwt.		188/-	..
a Sulphate of Magnesia .. .. per ton		£4 10	..
a Sulphur, Sublimed Flowers .. per ton		£6 10	..
a ,, Recovered .. .. per ton		£5 10	..
a ,, Lump .. .. .. per ton		£5	..
a Soda. Caustic (white 70 %) .. per ton		£10 15	..
a ,, Crystals .. .. .. per ton		£8	..
a ,, Bichromate, casks .. .. per lb.		2½d.	..

METALS, &c.

b Aluminium Ingots, in ton lots .. per ton		£130	..
b ,, Wire, in ton lots .. per ton		£168	..
b ,, Sheet, in ton lots .. per ton		£166	..
p Babbitt's metal ingots .. .. per ton		£43 to £135	..
c Brass (rolled metal 2' to 12') basis per lb.		7d.	..
c ,, Tube (brazed) .. .. per lb.		8¾d	..
c ,, ,, (solid drawn) .. .. per lb.		7¾d.	¼d. dec.
c ,, Wire, basis .. .. .. per lb.		7¼d.	..
c Copper Tubes (brazed) .. .. per lb.		8 1/2d.	¼d. dec.
c ,, ,, (solid drawn) .. per lb.		9d.	¼d. dec.
g Copper Bars (best selected .. per ton		£68	£3 dec.

METALS, &c. (*continued*).

g Copper Sheet .. .. .. per ton		£68	£3 dec.
g ,, Rod .. .. per ton		£68	£3 dec.
e ,, (Electrolytic) Bars .. per ton		£65	..
e ,, ,, Sheets .. per ton		£75	..
e ,, ,, Rod .. per ton		£67	..
e ,, ,, H.C. Wire per lb.		8d.	..
f Ebonite Rod .. .. .. per lb.		3/8	..
f ,, Sheet .. .. .. per lb.		3/-	..
n German Silver Wire .. .. per lb.		1/6	..
h Gutta-percha fine .. .. .. per lb.		8/-	..
h India-rubber, Para fine .. .. per lb.		4/1 to 4/4	3½d. dec.
i Iron, Charcoal Sheets .. .. per ton		£18	..
i ,, Pig (Cleveland warrants) per ton		43 6	1/7½ dec.
i ,, Forgings, according to size per ton		From £11	..
i ,, Scrap, heavy .. .. per ton		47/6 to 50/-	..
i ,, Wire, galvanised No. 8 .. per ton		£9 15	..
g Lead, English Ingot .. .. per ton		£11 5 to £11 7 6	2/6 to 5/- dec.
g ,, ,, Sheet .. .. per ton		£13	..
m Manganin Wire No. 28 .. .. per lb.		8/-	..
g Mercury .. .. per bot.		£8 7 6	..
d Mica (in original cases) small .. per lb.		4d. to 1/6	..
d ,, ,, ,, medium per lb.		2/6 to 3/9	..
d ,, ,, ,, large .. per lb.		4/- to 7/9	..
p Phosphor Bronze, plain castings per lb.		1/- to 1/2½	..
p ,, rolled bars & rods per lb.		1/1 to 1/4	..
p ,, ,, strip & sheet per lb.		From 1/2	..
o Platinum .. .. per oz.		£4	..
p Silicium Bronze Wire .. .. per lb.		10d. to 1/-	..
i Steel, Magnet, acc'd'g to desc'p'n per ton		£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block .. .. per ton		£118 to £119	10/- inc.
g ,, Foil .. .. per lb.		1/6	..
n ,, Wire, Nos. 1 to 16 .. .. per lb.		1/6	..
p White Anti-friction Metals— "White Ant" brand .. per ton		£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls per lb.		8d.	..
j ,, 6 lea. Flax .. .. .. per lb.		5¾d.	..
j ,, 8 ply 10 lbs. Russian .. per lb.		4 1/2d.	..
j ,, 10 lbs. Russian, single .. per lb.		4¼d.	..
j ,, 180 lbs. Jute rove .. per ton		£11	..
k Zinc, Sh't (Vieille Montagne bnd.) per ton		£23 15	10/- dec.

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Oct. 10	1,140	+268	24,870	+ 3,541	10	—
	Birmingham	,, 10	5,314	+162	208,536	+ 9,192	—	—
	Bournemouth	,, 7	974	—	—	—	10½	—
	Blackburn	—	—	—	—	—	12½	+1½
	Blackpool	,, 8	677	— 95	33,949	— 245	8½	—
	Blackpool and Fleetwood	,, 10	429	— 29	18,403	— 152	7½	—
	Bolton	,, 11	1,768	+133	52,943	+ 6,918	25	—
	Bradford	—	—	—	—	—	41	+4
	Brighton	,, 11	857	— 1	40,977	—	6½	—
	Bristol	,, 9	5,013	+472	—	—	28	—
	Burnley	,, 10	826	+144	—	—	7½	—
British Elec. Trac. Co.	Barnsley District ..	,, 2	190	—	7,165	—	4½	—
	Devonport	,, 2	532	+122	17,939	+ 667	5	—
	Dudley—Stourbridge..	,, 2	905	+116	33,828	+ 2,265	18¾	—
	Gateshead	,, 2	960	+ 91	34,233	+ 4,708	10½	+ ½
	Gravesend—Northfleet	,, 2	296	+ 99	9,629	+ 880	5½	—
	Greenock—Pt. Glasgow	,, 2	688	+ 52	21,850	+ 1,692	7½	—
	Hartlepool	,, 2	299	+ 67	10,801	+ 603	6½	+2
	Kidderminster	,, 2	131	+ 2	5,284	+ 186	4½	—
	Merthyr	,, 2	212	+ 13	7,653	— 225	3	—
	Middleton	,, 2	313	+ 45	12,995	+ 1,610	8½	—
	Oldham—Ashton ..	,, 2	595	+ 26	22,690	+ 1,524	8	—
	Peterborough	,, 2	176	—	5,881	—	—	—
	Poole	,, 2	378	+ 49	12,848	+ 1,848	3½	—
	Potteries	,, 2	1,738	+ 99	61,718	+ 3,907	28½	—
	Rothesay	,, 2	186	+ 7	6,484	+ 1,619	2½	—
	Sheerness	Sep. 30	71	—	2,387	—	2½	—
	Southport	Oct. 2	382	+101	12,768	+ 2,909	6½	—

* Compared with the corresponding period of 1902.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
B.E.T. Co.	South Staffordshire ..	Oct. 2	1,066	+303	35,578	+ 5,268	21½	— ½
	Swansea	,, 2	533	+ 37	20,696	+ 1,716	5½	—
	Taunton	,, 2	86	+ 27	2,469	— 197	1½	+1½
	Tynemouth	,, 2	318	— 4	13,006	+ 882	3½	—
	Weston-super-Mare..	Sep. 30	112	— 14	5,308	— 472	2½	+2½
	Wolverhampton Dist.	Oct. 2	402	+ 66	15,542	+ 7,180	10½	+8
	Wrexham	,, 2	147	—	3,336	—	—	—
	Yorks. Woollen Dist..	,, 2	501	—	11,749	—	6	—
	Cardiff	,, 10	2 015	+480	56,346	+16,546	14	—
	Chatham & District Co.	,, 8	629	+ 86	21,802	+12,894	8·53	—
	Dover	,, 10	225	+ 11	9,316	+ 109	3	—
	Dublin	,, 9	4,978	+458	61,686	+ 7,397	46½	+ ½
	East Ham	,, 10	667	+189	19,574	+ 5,922	6	+ ½
	Glasgow	,, 10	14,091	+1689	260,445	+29,919	66	+ 9
	Hull	,, 10	2,217	+ 84	51,833	+ 2,580	11	+ 1
	Ilkeston	,, 7	172	—	—	—	4	—
	Isle of Thanet	,, 10	474	— 25	20,027	— 1,501	10½	—
	Leeds	,, 10	5,422	+595	159,467	+10,000	41	—
	Liverpool	,, 3	10,784	+ 613	403,874	+18,156	102	—
	Manchester	,, 10	11,712	+6290	332,587	+204,638	72	—
	Newcastle	,, 10	3,736	+716	—	—	17	—
	Portsmouth	,, 10	1,703	+264	—	—	29	—
	Salford	—	—	—	—	—	30	—
	Southampton	,, 8	1,061	+114	—	—	9	—
	Sunderland	,, 11	1,139	+ 29	36,506	+ 1,864	20	+3
	Central London Railway	,, 10	6,504	—354	91,140	— 4,556	6	—
	City and S. London Ry.	,, 11	2,749	—600	87,323	— 5,302	6½	—
	Dublin and Lucan Elwy.	,, 11	122	+ 9	2,165	+ 160	6½	—
	Liverpool Overhead Ry.	,, 11	1,562	+ 92	25,589	+ 1,759	6	—

THE BRITISH ASSOCIATION, SOUTHPORT, 1903.

EXPERIMENTS FOR IMPROVING THE CONSTRUCTION OF PRACTICAL STANDARDS FOR ELECTRICAL MEASUREMENTS.

(Read before Section A)

(*Continued from page* 599.)

Since 1901 comparisons between Flat and the manganin standards of the Association have been made. Table IV. gives the observed values in ohms.

Table IV.—*Values at* 16° *C. in terms of* (1·01358 × *Flat*), *assuming Flat unchanged.*

Year.	Wolff, 1,690	Wolff, 780	Wolff, 381	Wolff, 147
1901	1·00012	1·00002	1·00014	·99790
1902	·99995	·99987	·99999	99783
1903	·99995	·99987	·99999	·99783

The values of 1,690, 780, 381, and 147 diminish by 17, 15, 15, and 7 times 10^{-5} ohms respectively in the interval 1901-1902. No. 147 is known to be a variable coil of very low insulation resistance, and may be disregarded for the purpose of estimating the change in Flat. It is of interest as being a coil brought to Cambridge by Dr. Lindeck in 1892 and left with the secretary.

Thus the apparent *falls* in value of 3,715, 264, 269, 270, 288, 289, 1,690, 780, and 381 are respectively ·017, ·015, ·020, ·017, ·017, ·017, ·017, ·015 and 015 per cent., giving a mean of ·017 per cent.

This justifies the assumption of a *rise* in resistance of B.A. Flat of ·017 per cent. in the period 1901-02.

The following tables, V. and VI., are I. and II. revised. They take the change in Flat into account by means of corrections applied to the observations of the years 1902 and 1903. The values given are for 16° C.

Table V. (I. *Revised*). B.A.U.

Year.	Constant Flat. F	G	H	Constant (1·01358 × Flat). Nolder, 3,715	Elliott, 264	Elliott, 269	Elliott, 270
1888	$+47\times10^{-5}$	$+91\times10^{-5}$	$+77\times10^{-5}$	—	—	—	—
1890	−17	+112	+90	—	—	—	—
1891	—	—	—	—	$+11\times10^{-5}$	—	—
1892	−18	+108	+92	—	—	—	—
1894	—	—	—	-17×10^{-5}	—	-37×10^{-5}	$+27\times10^{-5}$
1897	—	—	—	—	—	—	—
1898	−36	+99	+69	−17	+ 9	−46	+27
1900	−47	+92	+63	−17	+23	−59	+27
1901	−42	+92	+70	−17	+23	−54	+27
1902	−50	+78	+59	−17	+21	− 6	+ 7
1903	−50	+58	+59	−17	—	−56	+27

Table VI. (II. *Revised*). Ohms.

Tables VII. and VIII. being III. and IV., similarly revised, show no marked change in any of the coils in those tables excepting 147.

Table VII (III. *Revised*).
Values at 16° *C.*

Year.	(1·01358 × Flat.) Elliott 2-8.	Elliott 2-9.
1897	-27×10^{-5}	$+7\times10^{-5}$
1898	−·27	+7
1902-3	−27	+7

Table VIII. (IV. *Revised*).

Year.	Wolff, 1,690.	Wolff, 780.	Wolff, 381.	Wolff, 147.
1901	1·00012	1·00002	1·00014	·99790
1902	1·00012	1·00004	1·00016	·99800
1903	1·00012	1·00004	1·00016	·99800

With reference to Tables V. and VI. the data for 1901-1903 show a rise of ·008 per cent. for F, ·034 per cent. for G, and ·011 per cent. for H, indicating that they are certainly changing coils, the resistance for this period increasing with time.

From the values recorded 3,715 and 270 we have evidence that Flat has probably remained constant for the period 1894-1901. Also we infer that 264 is not a coil showing *very* great changes.

Between the years 1892 and 1898 the differences between Flat and the coils F, G and H alter by the amounts ·018 per cent., ·009 per cent. and ·023 per cent. respectively. The dissimilarity of these percentage-differences is further evidence that the coils have changed amongst themselves in this period. Comparing the amounts with those of the period 1901-1903, they represent quite normal increments of resistance. The balance of evidence in consequence is in favour of the constancy of Flat over the period 1892-1898, and this constancy has therefore been assumed.

A summarised statement of the platinum-silver coils of the Association will now be as follows:—

Table IX.—*Showing the Percentage-increase in Resistance of B.A. Platinum-silver Coils from* 1888.

Coil	1888	1890	1891	1892	1894	1897	1898	1900	1901	1902	1903
Flat	—	—	—	—	—	—	—	—	—	·017	·017
F	—	·064	—	·065	—	—	·083	·094	·089	·097	·097
G	—	−·021	—	−·017	—	—	−·008	−·001	−·001	·018	·033
H	—	−·013	—	−·015	—	—	·008	·014	·007	·018	·018
3715	—	—	—	—	obs. com-m'nce	—	0	0	0	0	0
264	—	—	obs. com-m'nce	—	—	—	·004	−·010	−·010	−·008	—
269	—	—	—	—	obs com-m'nce	—	·009	·022	·017	·019	·019
270	—	—	—	—	obs. com-m'nce	—	0	0	0	0	0
288	—	—	—	—	—	obs. com-mence	0	—	—	—	0
289	—	—	—	—	—	obs. com-mence	0	—	—	—	0

It will be observed that a number of the coils are steadily rising in value. The insulation remains good.

Temperature Coefficients of B.A. Coils.

Some special observations have been made in order to obtain the temperature coefficients of the coils. These were carried out by keeping the standard coil constant and subjecting the tested coil to various temperatures for 12 or more hours so as to ensure no lag. It is interesting to note that the temperature coefficients of some of the coils are appreciably different from the old values of 1892.

Table X.—*Showing the old and new values of the Temperature Coefficients of Various Coils.*

Coil.	Temperature coefficient old value, per 1° C.	Temperature coefficient new value, per 1° C.
Flat	·000277 B.A.U.	·000271 B.A.U.
F	286 „	268 „
G	274 „	274 „
H	271 „	280 „
3,715	000260? ohm	·000307 ohm
264	312 „	283 „
269	—	285 „
270	—	315 „

Comparison of the Unit of Resistance Employed at the Reichsanstalt and that of the N.P.L.

By the N.P.L. unit is meant the unit of resistance as obtained from the old B.A. coils.* Assuming that all the changes have been successfully interpreted, the unit at present employed in the laboratory should be the same as that employed in the Cavendish Laboratory in 1898 and at Edinburgh in 1892.

A comparison of the two units was rendered possible in the spring. Two Wolff coils, Nos. 780 and 738, of nominal values 1 ohm and 10 ohms respectively, were despatched to Germany last winter. Their values were determined in Reichsanstalt units (termed international ohms) in March, and the coils immediately returned to the laboratory. Unfortunately both coils fell in value two or three parts in the hundred-thousandth figure during their journeyings. The values given in the table are those determined on their return.

In addition, five new coils were received varying in value from $\frac{1}{10}$th to 10,000 ohms. These enabled a more complete comparison to be made. The laboratory value was deduced by building up from the unit, and also by direct comparison with coils of similar value.

Table XI.—*Results of Measurements of various coils at the Reichsanstalt and at the Laboratory, March,* 1903.

Coil No.	Laboratory Value at 17° C.	Value Deduced from Reichsanstalt Certificate at 17° C.	Laboratory Value—Reichsanstalt Value. Percentage Diff'r'nce.
2 352	·100007	·099996	·011 per cent.
2,351	1 00011	1 00001	·010 „
780	1·00001	·99991	·010 „
738	$9\cdot9994_5$	$9\cdot9985$	$\cdot009_5$ „
2,450	100004	99 993	·011 „
2,449	1,000 06	999 96	·010 „
2,448	10,000 9	9,999 8	·011 „

It is evident from these observations that a difference of $\cdot010_5$ per cent. exists, or that—

Resistance of Reichsanstalt unit—Resistance of Laboratory unit = $\cdot00010_5$ ohm . . . . . (A)

* 1 N.P.L. unit = 1·01358 B.A.U.

Comparison of the Unit of Resistance Employed at the Board of Trade and that of the Laboratory.

The comparison of these two units is not so complete. Two platinum-silver units and one of manganin have been determined at both laboratories. The measurements taken at Teddington indicate that no change resulted during the journeyings of the coils. In addition, one 1,000-ohm coil (Nalder, 6,863), has been determined.

TABLE XII.—*Results of Measurements of Various Coils at the Board of Trade Offices, and at the Laboratory, February and March*, 1903.

Coil No.	Temperature.	Laboratory value.	Deduced B.O.T. value.	Laboratory value—B.O.T.
Elliott, 270	16·0° C.	1·00006	$1·00010_5$	$-·004_5$ per cent.
Elliott, 264	16·0° C.	1·00008	$1·00014_5$	$-·006_5$ "
Wolff, 381	16·0° C.	1·00015	$1·00021_7$	$-·006_7$ "
Nalder, 6,863	15·84° C.	999·13	$999·1_8$	—

The exact relationship between the B.O.T. unit and that of the laboratory is therefore still incomplete. It seems fairly certain however that—

Resistance of Laboratory unit—Resistance of B.O.T. unit = ·00006 ohm, a difference of ·006 per cent. . . (B)

From the two relationships—

Resistance of Reichsanstalt unit—Resistance of N.P.L. unit = $·00010_5$ ohm.

Resistance of Laboratory unit—Resistance of B.O.T unit = ·00006 ohm,

we have

Resistance of Reichsanstalt unit—Resistance of B.O.T. unit = 00016_5 ohm, a difference of $·016_5$ per cent. . (C)

The present values of the B A. coils are as follows:—

TABLE XIII.

Coil.	Temperature.	Resistance.	Temperature coefficient per 1° C.
Flat	16·0° C.	1·00050 B.A.U.	·000271 B.A.U.
F	"	1·00083 "	·000268 "
G	"	·99975 "	·000274 "
H	"	·99976 "	·000280 "
3,715	"	1·00050 ohm	·000307 ohm
269	"	1·00089 "	·000285 "
270	"	1·00006 "	·000315 "
288	"	10·0060 "	$·0031_0$ "
289	"	10·0026 "	$·0026_5$ "

The Wolff manganin coils of the Association are also given at 16° C., with a temperature coefficient to be applied for small ranges of temperature only, since it is by no means a linear function.

TABLE XIV.

Coil.	Temperature.	Resistance.	Temperature coefficient per 1° C.
1,690	16·0° C.	1·00012 ohm	·00001 ohm
780	"	1·00002 "	·00001 "
381*	"	1·00016 "	·00002 "
147	"	·99800 "	$·00001_5$ "

* No. 381 is a manganin coil belonging to the Board of Trade.

As has already been explained, the values are given in terms of the Laboratory unit, which represents 10^9 C.G.S. units of resistance as determined by Lord Rayleigh and Mr. Glazebrook at Cambridge; it has been assumed that the inter-comparison of the coils enables that unit to be recovered.

Appendices I. and II. of the present Report afford the means of connecting this unit with those of the Board of Trade, derived from it in 1891, and of the Reichsanstalt, and also with the ohm or international ohm—the resistance, that is, of a certain column of mercury.

APPENDIX II.

The relation between the international ohm (106·300 *cm. Hg. weighing* 14·4521 *gms. at* 0° *C.*) *and the unit of resistance employed at the N.P.L. Preliminary note, by* F. E. SMITH.

(*From the National Physical Laboratory.*)

The following measurements of six mercury tubes indicate the progress made in this inquiry, and also the relation obtained:—

Tube.	L	Conical correction.	Theoretical length for 1 int. ohm.	a	b	b—a
	Length at 0° C.	$(\mu-1)\times 10^6$.		Calculated resistance of tube int. ohm.	Mean measured resistance. Lab. unit.	
U	62·0731	5_8	62·1319	·99905	·99913	·00008
V	73·5000	18	73·4759	1·00033	1·00041	·00008
G	116·507	9	116·478	1·00025	1·00035	·00010
X	65·6338	2_8	65·6354	0·99997	1·00007	·00010
Y	62·1867	15	62·2382	·99917	·99926	·00009
Z	68·5199	8	68·5057	1·00021	1·00029	·00008

Thus, laboratory unit of resistance = ·99991 int. ohm.

$$= \frac{106·291}{106·300} \text{ int. ohm.}$$

[The above figures are intended as merely provisional.]

With respect to the measurements of the cross-sections, the uniformity of the results shows that an accuracy of ·001 per cent. may be relied upon. Four methods of measuring the resistance will be employed. At present only two of these are completed. The values in each horizontal line refer to different fillings; they are quite concordant, as the values given in the following table show:—

Resistance in Laboratory (N.P.L.) Units of Mercury Tubes.

Tube.	Resistance at 0° C. Potentiometer.	Resistance at 0° C. Kelvin double bridge.
U	·99913	·99913
	·99912	·99912
	·99914	·99914
V	1·00041	1·00041
	1·00044	1·00044
	1·00040	$1·00039_5$
G	1·00034	1·00035
	1·00036	1·00036
	1·00035	1·00035
X	1·00007	1·00007
	1·00006	1·00006
	1·00007	1·00006
Y	·99926	·99926
	·99927	·99926
	·99925	·99925
Z	1·00030	1·00030
	1·00029	1·00029
	1·00029	1·00029

(*To be continued.*)

REVIEW.

Trade and Empire. By JOHN B. C. KERSHAW, F.I.C., F.S.S. London: P. S. King & Son, Orchard House, Westminster.

Too large to be described as a Tract for the Times, too small to be referred to as a book, Mr. Kershaw's work may be stated to be a substantial pamphlet on the question of the hour, with the further recommendation that it occupies an exceptional position amongst writings on this subject, in that Mr. Kershaw places his facts and arguments before his readers in sober language, and free from the denunciation and invective which are so prevalent amongst Fiscal Policy propagandists. This is, perhaps, in part because he wrote before the controversy became a controversy, the present work being, in the main, a republication of articles in the "reviews" from 1897 to the present year. In his preface, the author relates that he commenced his inquiry in 1897 as a Liberal Free Trader, and "ended it in 1901 with opinions that are fully set forth in the third and fourth articles of the series." The third and fourth articles of the series are entitled "The Promotion of Trade within the Empire," and "The Colonial Office Conference and Preferential Trade within the Empire." They were respectively published in June, 1902, and February, 1903, and they contain much that has recently been very much enlarged upon.

Open to criticism or commendation as the contents of such a work must be, according to the standpoint of the "reviewer," we prefer to leave the criticism to the reader, and to recommend all who desire to study the fiscal problem to get Mr. Kershaw's work and form their own conclusions.

AUSTRALASIAN ELECTRICITY WORKS.

WE are indebted to the proprietors of the *Ironmonger* for permission to reprint the following table of Australasian electric light and power works from *Australasian Hardware and Machinery*. The statistics are corrected up to August last:—

ELECTRIC SUPPLY STATIONS OF AUSTRALASIA.

Locality.	Date of commence't of supply.	Supply authority or company.	Engineer or manager.	Secretary or Town Clerk.	System employed.	Voltage at consumers' terminals.	No. of consumers.	No. of incan. d'sc't lamps, equiv. 16 C.P.	No. of arc lamps.	Horse-power in motors.	Capacity of plant. KW.	Capacity of plant. Equiv. 16-C.P. lamps.	Boilers, No. and horse-power.	Engines, No. and horse-power.	Dynamos, No. and kilowatts.	Price per unit. Lighting.	Price per unit. Power.	Price o' gas in neighbourhood.	Remarks.
Sydney ..	..	Corporation ..	— Rooke ..	T. H. Nesbitt ..	A.C., 3-ph.	240	..	..	340	..	1,500	25,000	5 x 700 H.P. B. & W.	2 x 1,000 & 1 x 500 Ferranti	2 x 600 & 1 x 300 KW. Dick, Kerr	4½d.	2d.	4/-	Plant under erection.
„ ..	1897	Empire E.L. Co.	J. R. W. Gardam	R. O. Robberds	D.C. ..	200	..	8,500	..	180	400	6,400	4 x 140 H.P. B. & W.	3 x 90 H.P. & 2 x 165 Alley & McLellan	3 x 60 KW. & 2 x 110 KW. Parker	6d.	4½d.	4/-	115 Tudor cells.
„ ..	1894	George Adams ..	W. J. Adams ..	A. E. Blair ..	D.C., 2-wire	110	..	..	..	90	260	4,200	3 multitubular ..	2 x 150 H.P. & 1 x 60 H.P. Willans ..	2 x 90 KW. & 1 x 45 KW. Siemens	5d.	4d.	4/-	
„ ..	..	Strand E.L. Co.	John Kent ..	..	D.C., 3-wire	110	..	..	..	150	858	14,300	7 x 150 H.P. multitubular.	2 x 150 H.P. univer. 6 x 150 H.P. Willans	2 x 110 KW. Brush 2 x 125, 2 x 46 Siemens, 1 x 50 Royce	4½d.	..	4/-	
„ ..	1848	Oxford E.L. Co.	H. Langen ..	..	D.C., 2-wire	220	20	1,200	18	Nil	72	1,200	2 x 75 H.P. mult.	2 x 50 H.P. univer.	2 x 36 KW. Mordey	5d.	..	4/-	Extensions in view.
Redfern ..	1892	Corporation ..	J. W. Balfour ..	R. W. Grierson	A.C., 1,000 v. 70 cycles.	200	122	3,000	26	45	240	3,800	2 x 200 H.P. multitubular.	2 x 200 H.P. hor. comp.	2 x 120 Mather and Platt.	5½d.	3d.	4/-	Public light by 100 G.E. series enclosed arc lamps.
Tamworth	1889	Municipal Coun.	W. G. Counsell	W. Hughes ..	D.C., 2-wire	220	..	250	10	Nil	44	700	2 x 30 H.P. multitubular.	2 x 30 H.P. comp. Fowler undertype	2 x 22 KW. Crompton.	..	..	7/6	Public lighting only.
Penrith	..	Corporation ..	..	..	A.C., 1,000 v. 100 cycles.	50	..	..	Nil	Nil	40	640	2 x 30 H.P. loco.	2 x 30 H.P.	2 x 20 KW. B.T.H.	..	..	..	£1 per lamp year.
Broken Hill	1890	B.H.E.L. and P. station	F. J. Mars ..	..	A.C., 1,100 v. 100 cycles.	110	150	2,000	25	8	220	3,500	3 x 90 H.P. B. & W.	2 x 100 H.P. Westgh. 1 x 200 H.P. Belliss	1 x 70 KW. A.E.G. 1 x 50 KW. Mordey 1 x 110 KW. Brown	1/3 and 6d.	¢d.	15/-	Fan motors.
Hillgrove ..	..	Hillgr. and Armidale E. Cor. Ld.	A. L. Cadogan ..	E. J. Erskine ..	A.C. light., D.C. power..	110 & 1,500	60	528	2	200	530	8,500	Water-power ..	..	3 D.C., 2 A.C. Crompton	..	..	None	Power for mining.
Lambton ..	..	Corporation ..	..	..	A.C....	..	..	..	..	..	..	..	..	..	..	..	..	..	
Mossvale ..	..	M.V.E.L. Co. ..	W. Clegg.. ..	H. Richardson..	A.C....	100	30	400	Nil	Nil	..	..	..	..	..	..	..	..	
Newcastle	1891	Corporation ..	W. A. Jones ..	E. S. Holland ..	A.C., 1,000 v.	..	Nil	631	23	Nil	90	1,500	25 & 8 Loc. Willans	..	Mordey	6d.	..	..	
Young ..	1888	Corporation ..	H. J. Spencer ..	G. E. Spark ..	A.C., 1,100 v. 100 cycles	52 & 104	140	1,060	1	Nil	75	1,500	2 x 86 B. & W. .. 2 x 90 H.P. multilocomotive ..	2 x 130 Westgh. .. 2 Fowler Undertype Comp. ..	2 Westinghouse .. 3 T.H., 25 KW. ..	8d.	..	4/7 None	Public lighting only. Rate per 16-C.P. lamp, 5½d. and 8d. per week.
Melbourne	1894	Corporation ..	H. R. Harper ..	J. Clayton ..	D.C. & A.C.	230 & 100	1,142	43,088	1,254	481	2,434	37,300	4 x 250 H.P. B. & W. 4 x 500 H.P. „	5 Belliss, 1 Peache (comp.); 4 Aust. Otis. Robey type	4 x 75 T.H. Altrs. 1 x 150 Johns. & P. 4 x 350, 1 x 200 P.ds. 24 T.H. Arc Ltrs.	5d.	3d.	5/-	D.C. 3-wire in centre of city. A.C. 2,000 v. in outskirts.
„	1889	E. L. & T. Co. ..	F. W. Clements	W. J. Mountain	A.C., 4,000 v. 50 cycles	200	695	15,800	195	265	1,200	20,000	8 x 250 H.P. B. & W.	2 x 900 H.P. & 1 x 400 Brush Univers.	2 x 500 & 1 x 200 KW. Brush In. Alts	6d.	2d.	5/-	
Geelong ..	1901	E.L. & T. Co. of Aust.	F. W. Clements	W. J. Mountain	D.C., 3-wire	220	240	3,600	32	182	320	5,200	Semi-marine ..	Belliss compound	Brush	7d.	2½d.	6/8	
Bendigo ..	1892	E.S. Co. of Vic.	B. Sluytermann	G. S. Morison ..	A.C. & D.C.	100	112	1,950	81	76	165	2,600	4 x 70 H.P. B. & W.	5 x 70 H.P. comp...	3 x 25 KW. Brush 4 x 12 KW. arc ltrs. 1 x 40 KW. Ganz AC	8d.	8d.	8/4	
Ballarat ..	1894	E.S. Co. of Vic.	..	..	D.C., 3-wire	..	..	..	..	..	122	..	..	..	..	..	..	..	
Nhill ..	1891	N.E.L. Prop. Co.	J. C. Lockley ..	..	D.C. ..	..	..	..	..	..	33	550	..	..	..	..	..	..	
Moolort ..	1901	D.L. E.T. Co. ..	..	..	3-phase ..	..	..	..	..	..	800	13,000	..	90 H.P.	..	..	..	None	Power for mining only.
Brisbane ..	1888	B.E.S. Co., Ld.	E. C. Barton ..	W. M. l'Estrange	D.C., 3-wire	110	160	..	80	80	375	6,200	Lancashire ..	2 x 80 Raworth, 1 x 80, 1 x 120, & 1 x 240 Parsons	2 x 50 Parker, 1 x 50, 1 x 75, & 1 x 150 Parsons	4½d.	2d.	5/-	Output 200,000 units; 40 motors and 120 fans.
Charters Towers	1897	C.T. E.S. Co. ..	F. Warden ..	A. W. Wilson ..	A.C., 2,200 v.	100 & 200	101	1,713	Nil	Nil	80	1,300	2 x 80 H.P. multitubular . ..	2 x 70 H.P. Browett-Lindley	2 x 40 KW. Crompton	1/-	..	13/4	
Rockhampton	1892	R. G. & C. Co., Ltd.	R. Silcock ..	A. Lloyd	D.C., 2-wire	110	53	520	18	10	47	800	2 Knapps, Root ..	Paxman, Globe, Westinghouse	Hookham, Brush, Crompton	1/- & 9d.	7d.	11/3	3-wire laid, running 2-wire.
Adelaide ..	1900	E.L. & T. Co. of Aust.	F. W. Wheadon	H. Ashworth ..	D.C., 3-wire	200	427	9,861	177	409	760	13,000	3 x 200 H.P. B. & W.	2 x 260 and 2 x 360 H.P. Willans, 2 x 150 H.P. Tosi	2 x 100 and 2 x 200 KW. Bruce Peebles 2 x 80 KW. Ganz	7d.	2½d.	6/-	H.T. system in hand for suburbs.
P't Adelaide	1899	„ „	„ „	„ „	A.C., 2,000 v. 50 cycles D.C., 3-wire	200	103	1,795	57	12	120	1,900	3 Cornish	5 Alley & Macellan	5 Johnson and Phillips	7d.	2½d.	7/6	
Hobart ..	1898	H. Gas Co. ..	A. J. Todd ..	W. J. Campbell	A.C.	110	100	3,728	80	59	252	5,040	1 60-H.P. loco., 2 B.& W. 150 H.P. multi.	2 x 150 Willans, 1 x 80 Crossley gas	2 x 100 KW. Siemens 1 x 52 Siemens	8d.-6d.	3d.	6/8-6/3	
Launceston	1896	Municipal Coun.	Wm. Corin ..	C. W. Rocher ..	3-phase, 5,000 v.	110 & 190	1,787	13,600	154	156	1,200	20,000	Water-power ..	4 x 500 Kolben turbines	4 x 300 Kolben ..	6d. & 1½d.	2d. & 1d.	7/1	Max. demand indicators, 3-phase 4-wire distribution.
Devonport	1903	Town Board ..	G. H. Lofts ..	B. C. Greene	D C., 3-wire	220	..	..	..	10	..	40	..	1 x 70 H.P. Climax	1 x 65 Belliss ..	1 x 40 Brush ..	8d.-3d.	3d.-2d.	..	Battery, 240 Tudor cells.
Perth ..	1893	Perth Gas Co. ..	H. Broadbent ..	T. Blackney ..	D.C., 3-wire	220	1,320	20,000	250	200	1,015	16,500	4 x 106 & 2 x 1,000 H.P. B. & W.	4 x 80 & 3 x 160 H.P. Willans & 1 x 850	4 x 50,3 x 105 Castle & 500 Dick, Kerr	7d.-4d.	5d.-2d.	7/6	Mechanical stokers, condensers, cooling tower.
Kalgoorlie	1901	K. Power & Lt. Co.	C. E. Crocker ..	..	3-phase ..	550	..	..	..	..	1,500	24,000	8 x 300 H.P. B. & W.	3 x 800 H.P. Stewart	3 x 500 G.E.Co., 600	9d.-5d.	6d.-3d.	..	
Coolgardie	—	E.S. Co. of W.A.	..	..	D.C. ..	220	..	..	..	..	220	3,500	[Loco.	2 x 200 H.P. Willans	2 x 120 [Dick, Kerr	..	..	..	
Boulder ..	1899	Corporation ..	J. Schmidt ..	E. J. Powell ..	D.C. 3-wire	220	125	3,400	43	1	120	2,500	1 x 120 B.& W., 1x 90	1 x 80, 2 x 32 H.P.	2 x 40 & 2 x 20 ..	1/1	1/1	None	Battery. 3/118 ampere-hours.
Wellington	1888	W. E. L. and P. Co.	G. S. Maben ..	J. P. Brandon ..	A.C. ..	100	2,350	37,000	140	372	1,250	20,000	4 x 130 H.P. Econ., 2 x 210 H.P. B.-W. 2 x 212 H.P. B.-W.	2 x 600 Browett, 1 x 550, 1 x 300 Brush, 4 x 150 Paxman	2 x 300 Westh., 1 x 200, 1 x 150 Brush, 4 x 75 Gulcher	5d.-1/-	3d.	5/10	Street lighting by 850 incandescent lamps, 20 C.P. each, and 36 arcs of 15 amperes each.
Rotorua ..	1901	N.Z. Govt. ..	R. C. White ..	..	A.C., 4,000 v. 50 cycles	100	..	1,500	20	20	100	1,600	Water-power ..	2 x 100 H.P. Waverley turbines	2 x 50 KW. Brush inductor	6d.	..	None	13-mile transmission. sewerage pumping extension in hand.
Christchurch	1903	Corporation ..	L. Birks	H. R. Smith ..	D.C., 2-wire	220	..	..	..	..	200	3,200	2 x 250 H.P. B. & W.	2 x 160 Davey, Paxman	2 x 100 Westgh. ..	10d.-5d.	3d.-1d.	7/6	Refuse destructor. Bat. 124 Tud. c. 1,500 ampere-hours.

EXPLANATION OF ABBREVIATIONS.—A.C., Alternating Current; D.C., Direct Current; B. & W., Babcock & Wilcox boilers; KW., Kilowatts.

NOTE.—Connections to mains are expressed in 16 candle-power, 60-watt lamp equivalents, and do *not* include arc lamps or motors, which are detailed independently.

A SWANSEA ELECTRIC TRAMWAY SPECIFICATION.

Scope of Contract.—Contract A.—Supply and erection of poles and overhead equipment for about 8¼ miles of tramway route. Contract B.—Supply, delivery, laying, fixing, and connecting of ducts, troughs, cables, feeder boxes, &c., for above.

Number of Poles required.—574 A type; 101 B type.

Type of Pole.—To be either lap-welded steel tubes or solid drawn steel tubes. Type A, if lap-welded, to weigh 962 lbs., if solid drawn three-section tube 710 lbs, or if solid drawn stepped tube 650 lbs. Type B under similar conditions to be either 1 593 lbs., 1 050 lbs., or 1,019 lbs. The effective length of each pole to be 31 ft.

Pole Tests.—Temporary deflection not to exceed 6 in. with the following weights applied at a point 18 in. from end of pole, the pole being fixed for a distance of 6 ft. from other end:—Pole A, 750 lbs.; pole B, 2 000 lbs. Temporary deflection under similar conditions, for deflection 9 in., pole A, 1 350 lbs.; ditto. 8·5 in., pole B, 3,500 lbs. These latter weights are not to produce a greater permanent deflection than ½ in.

Pole Accessories.—To meet specification requirements, which are on the whole reasonable

Trolley Wire.—To be 2/0 S.W G. gauge.

Guard Wire.—To be seven-strand No. 8 galvanised steel wire, all guard wire span wire being sever-strand No. 14 similar wire. On certain sections to be phosphor bronze wire.

Overhead Fittings.—To have all metal parts made of bronze. Trolley ears to be not less than 18 in. Insulating material to be approved by engineer. Frogs to be operated in an approved manner.

Insulating Material Test.—After soaking in tepid water for one week to withstand when wiped dry, an alternating pressure of 2,000 volts applied for three minutes between metal parts.

Special Work.—The sum of £1,000 is to be reserved for special work involved in crossing one swing and one drawbridge across the docks. The successful tenderer will be required to submit a scheme for this part of the work.

Samples.—In connection with Contract A, 23 samples of materials proposed to be employed are to be sent in with each tender, and with regard to Section B, 27 samples, making 50 *samples*, for the two contracts.

Contract B.—This is divided into two sections, and tenderers must quote for both, one section includes the supply and delivery on site of the ducts, conduits and other stoneware required, the other the delivery of cables, feeder boxes, &c., and the laying and drawing-in of the whole of the material.

Type of Conduits.—To be of either Doulton & Co., Albion Clay Co., or other approved make. The multiple way ducts may, if preferred, be made up of a number of separate pipes not less than 3-in. internal diameter.

Tests for Ducts.—Among the specified tests are the following:—They must be able to withstand a pressure of not less than 23 tons applied vertically on top of ducts. After being dried and weighed, they shall be immersed in water for 16 hours, and reweighed. The increase in weight must not exceed 2¾ per cent.

Troughing.—A certain length of earthenware troughing is to be supplied and laid, the cables being embedded in solid bitumen.

Cables.—All cables to be of unsheathed waterproof non-hygroscopic type—*i.e*, insulated with vulcanised bitumen or similar material. At two points the cables have to be laid across the docks, and at these points are to be of a suitable submarine type, steel armoured.

Feeder Boxes.—Twenty-six to be supplied, each with six switches and fuses, two of 300-ampere capacity, four of 150-ampere capacity. Lightning arrester and telephone connections to be provided for each box.

Specified Date of Completion.—Twelve months, with the exception of certain specified portions, which must be completed in six months.

Penalty for Late Completion.—One per cent. of the total price of each contract for each week's delay beyond specified date.

Period of Maintenance.—Twelve months from date of completion.

Arbitration.—See comments.

Terms of Payment.—Eighty per cent. of value of work done on monthly certificates granted by the engineer, 10 per cent. when tramway is opened for traffic, 10 per cent. at end of period of maintenance.

Date for Receipt of Tenders.—October 31st, 1903.

This specification has been issued by Mr. C. A. L. Prusmann, the borough electrical engineer to the Swansea Corporation. In several respects it falls far short of the ideal which many of our best known engineers have been striving to reach in the specifications they have prepared during the past two years.

The general conditions are in many cases too binding upon the contractor and too lax in defining the responsibilities of the purchasers. The apparent aim of the compiler of the specification has been to avoid extras, the result being that the contractor must take all risks and include them at a price in his tender. The Corporation will find that this method will be far more costly than a demand for schedule rates from the successful tenderer for the work and the ordering of each item as it is found to be necessary by the engineer. It is stated that the specification is to receive a strict literal interpretation, and only questions of price are to be referred in cases of dispute to arbitration, and these after the work has been completed. Since in several points the clauses in the specification do not agree, literal interpretation is difficult, but in all probability the contractors would have little difficulty in securing the assent of the engineer to the necessary modifications of the phrasing.

It would be well for tenderers to agree together to ask for some limitations in the powers of the engineer; at present he may make such demands upon the contractor and yet keep within the letter of the general conditions that any chance of the contractor's meeting his expenses, let alone making a profit, may be destroyed. This will need to be done carefully, since tenderers are prohibited in the specification from making any modifications in any detail in their offer. It is, however, out of harmony with the spirit of the day to disqualify any tenderer who only takes exception to what is manifestly unfair.

Dealing with the specification itself the compiler in many cases specifies not only results, but also the means to be adopted to attain those results. In the case of cables it is asking too much for the contractors to provide the test pressure in either direct or alternating current at the desire of the engineer. Practically all makers arrange to test with alternating pressures, and might find it both expensive and inconvenient if suddenly called upon to supply high-pressure direct current.

It is open to the engineer to demand that a total length of *eight yards* shall be cut off *all or any lengths* of cable for the purpose of bending tests. The contract price is determined from a schedule at a fixed sum per yard laid, and no mention is made as to how the contractor is to charge for the 8 yards cut from possibly every drum of 400 yards or so. The specifications demand that no less than 50 samples are to be forwarded by each tenderer for the two contracts. This seems to be a needless inquisition, for in some cases such as 2 ft. lengths of ducts it is specified that they must be supplied by definite makers, and surely one sample of the same thing should be sufficient.

We feel strongly that the engineer is thus putting all tenderers to needless trouble and expense, by demanding what appears to be an excessive number of samples, without obtaining for his Corporation any corresponding advantage.

The present seems a case where the attention of the engineer might be drawn to the wide difference between the general conditions attached to his specification and the model set of general conditions as prepared and approved by the Institution of Electrical Engineers. It is possible that such an examination would result in the elimination of those clauses which, in their phrasing at least, appear to be contrary to the best practice of our time.

WOLVERHAMPTON AND THE LORAIN SYSTEM.

THE monthly meeting of the Town Council took place on Monday, and the principal business for consideration was a report from the Tramways Committee dealing first with the question of tramway intercommunication with the outlying districts, and next the proposed extension of the tramways on the Lorain system. On the question of intercommunication, the Committee in their report state that they fully considered the matter with a view to thoroughly and definitely settling it. The report proceeds:—

The routes to be dealt with are:—
(*a*) Dudley Road.
(*b*) Willenhall Road.
(*c*) Wednesfield Road.
(*d*) Waterloo Road.

There are other routes upon which the Corporation have power under the Corporation Act, 1899, to construct tramways, namely:—
(*e*) Penn Road (with which is combined Lea Road).
(*f*) From Prince's Square along Stafford Street, to Stafford Road and Cannock Road.
(*g*) From St. Mark's Church to Cleveland Road.

But with regard to these three routes your committee felt that the present is not for various reasons an opportune moment at which to report, nor is there any pressing necessity for carrying out these extensions, nor for out-lining now a future policy in regard thereto, save that such a policy must, to a certain extent, be governed by the submissions contained in this report with regard to routes *a*, *b*, *c* and *d*.

With respect to these latter routes, your committee instructed the borough electrical engineer to present figures which would show the comparative costs of equipping the lines, either on the Lorain surface contact or the overhead system.

In addition to these figures, your committee had to consider, when coming to a decision as to which system to recommend to the Council, the following points:—

1. The fact that the Council had already decided on the Lorain system for the Tettenhall, New Hampton Road and Bilston Road lines.
2. The question of a break of communication at the borough boundaries should the Lorain system be generally adopted.
3. The difficulties of operating a dual system within one area.
4. In case the overhead system should be adopted, the necessity of equipping either Piper's Row and Bilston Street with the overhead system, in addition to the existing Lorain system, or else the expense of fitting all overhead cars with skate attachment, and also
5. (Though common to both systems) the question of whether single or double track should be laid down along the routes to be constructed.

After thoroughly considering all these questions your committee came to the conclusion, with but three dissentients, that the system to be adopted on the routes *a*, *b*, *c* and *d*, must be the Lorain system. But your committee felt that they should also give in this report reasons for the conclusion at which they had arrived, and also make specific recommendations with regard to the question of double or single track, and as to the order in which the work of construction should be carried out.

The report then deals first with the question of the cost, &c., and next the break in communication at the borough boundaries. This is the deliverance of the Committee as to the cost:—

"Reference should be made to the detailed comparative statement of the borough electrical engineer, which shows the difference in capital cost and annual expenditure between the two systems; but this difference, although it received due consideration

from the Committee, was largely over-weighted by the fact that the Council had decided upon the Lorain system upon the Tettenhall, New Hampton Road, and Bilston Road routes; and consequently new factors had been introduced into the situation which would materially affect this monetary difference. The decision of the Council operated adversely to the overhead system being introduced into the borough, inasmuch as the borough electrical engineer advises, that should that system be adopted on any route within the town, it would entail the necessity of either equipping Piper's Row and Bilston Street with the overhead system in addition to the existing Lorain system, or else the expense of fitting overhead cars with skate attachment. For, unless the cars were made interchangeable, additional spare cars would have to be kept in the sheds to meet an emergency, in excess of what would be necessary if the undertaking were worked on one system. Besides this, there would be the many and important objections to the working of a dual system within one area of control. Again, preferential treatment would be accorded to the better class roads and streets of the town to the detriment of the inhabitants living in the poorer districts, were the overhead system to be laid down in any part of the borough after the Lorain system had been adopted for the Tettenhall, New Hampton, and Bilston Roads. On the other hand, should the Lorain system be adopted throughout, the necessity for the cars carrying two equipments, which would add materially to the amount of electric energy required to drive them, and the unsightliness and danger of the poles in some of the most important and crowded streets in the borough, would be disposed of.

"Taking all these facts into consideration, your Committee came to the conclusion that the difference in capital cost and annual expenditure between the two systems would be out-weighed by the advantages to be gained by the maintenance of one, and only one, system; and that the only possible policy is to extend the Lorain system throughout the borough."

Respecting the break in communication at the borough boundaries, the report proceeds:—

"Your committee had to consider whether the inconvenience of changing cars was such a serious drawback as to involve laying down the overhead system, especially considering the fact that the Corporation have no power to run outside the lines specified in the Wolverhampton Corporation Act, 1899. This question could only apply to the Dudley Road and Willenhall Road routes. In settling the point, your committee had to guide them, the fact that on the Bilston Road the break in through communication has had no serious effects, as has been practically tested by the traffic returns, which have steadily increased. For instance, the increase of passengers carried during the month of August this year was 26,849 (equivalent to £192 14s. 7d.), as compared with the same month last year, during the existence of the Exhibition, as is shown in the following table:—

—	Car-miles run.	Receipts.	Receipts per car-mile.	Passengers carried.
August, 1903	9,799	£485 8 6	11·89d.	97,096
August, 1902	6,487	292 13 11	10·83d.	70,247
Increase ...	3,312	£192 14 7	1·06d.	26,849

"To this argument should be added the important fact that it lies with the outside districts alone to determine that there shall always be an overhead car to meet a Wolverhampton car at the boundary, so as to minimise to the greatest extent possible the inconvenience consequent upon a change from one car to another. It is equally open to the outlying districts to bring pressure on the British Electric Traction Co. to run through cars into Wolverhampton, from Dudley, Bilston, and Willenhall. This would be quite possible in view of the fact that the Corporation, sometime ago, made an offer to the company which would permit them to run through cars into Wolverhampton (by affixing skate attachments), upon terms to be agreed upon, and failing agreement by reference to the Board of Trade, such terms acknowledging two broad principles, viz., that the Corporation must absolutely control its own traffic; and, secondly, that they should take all earnings within the borough. Any other arrangement, by which a competitive system would exist, would be prejudicial to the financial interests of the undertaking. It may be mentioned that shelters will be provided at the termini of the respective boundaries.

"Should the Council adopt the resolutions contained in this report, your committee would then be open to receive proposals from the company under the offer before alluded to, and to make such arrangements as might be found practicable and suitable. But, even if the company do not avail themselves of their power in this direction, your committee feel that the inconvenience of changing from car to car is not so great, especially if the two systems run in conjunction with one another, as to involve the adoption of the overhead system, and the consequent extra expense and innumerable difficulties. Therefore, your committee decided, that from this point of view also, they must advise the Council in favour of the Lorain system."

The Committee add that when the routes *a*, *b*, *c* and *d* are ready for traffic, the additional cars required to work them can be housed—and this whether they be on the Lorain or overhead system—by building an additional bay, as and when required, on to the existing car-shed, at a cost of about £4,000.

The report concludes with the following practical recommendations:—

That the Lorain surface contact system be adopted on the following tramway routes, viz., Dudley Road, Willenhall Road, Wednesfield Road, and Waterloo Road.

That the tenders of Mr. Herbert Holloway, of Wolverhampton, for the construction of the permanent way on the above routes, at the following sums, be accepted, viz.:—

Dudley Road...	£11,582 10
Willenhall Road	8,700 0
Wednesfield Road	7,482 1
Waterloo Road	6,200 0

That the consent of the Board of Trade be obtained, where necessary, to any alterations made under the authority of Section 28 of the Wolverhampton Corporation Act, 1899, and that the Town Clerk be empowered to apply for such consent, and to give all necessary notices to frontagers, if required, and to obtain their consents, if and when necessary.

That the routes above mentioned be equipped with the said system, in accordance with the prices scheduled to, and the terms contained in, the contract between the Corporation and the Lorain Steel Co., dated July 26th, 1901, subject, however, to such variation and modification as may be agreed upon between the Corporation and the company; and that the said routes be constructed and equipped in the following order, namely:—

(*a*) Dudley Road.
(*b*) Willenhall Road.
(*c*) Wednesfield Road.
(*d*) Waterloo Road.

That the Finance Committee be requested to raise all requisite moneys in such manner as they may deem most advisable, and, if necessary, to raise Wolverhampton Corporation stock, for the purpose of defraying the costs, charges and expenses of the works referred to in the foregoing recommendations.

[Three members of your committee, namely, the Mayor, Mr. Alderman Gibbons and Mr. Councillor Allen, voted against the adoption of this report.]

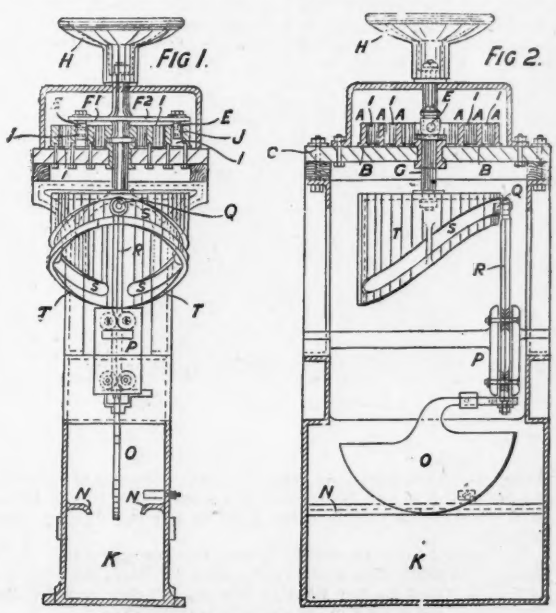
Appended to the report is a communication from Mr. W. A. Luntley, tramway manager, who speaks purely from an operating point of view. He says:—

"In my opinion, the introduction of a dual system of tramways in a town the size of Wolverhampton would lead to many difficulties, as, unless we kept a good number of spare cars for each system, we could not properly cope with the traffic on holidays or special times, such as Bank Holidays, race meetings, football matches, flower show, &c."

Since this article was written the Council has made up its mind, by a large majority, to extend on the Lorain principle. The proceedings at Monday's meeting are referred to in our "Traction Notes" to-day.

NEW LIQUID CONTROLLER.

Messrs. Steel, Peech & Tozer, Ltd., of Sheffield, and their electrical engineer, Mr. H. E. Bowen, have patented and put on the market a new liquid controller, designed to meet the requirements of general engineering work, and specially adapted to cope with



Sectional Elevations of Controller.

rough usage and dirt. It is a simple and compact device, having no gear wheels, balance weights, keyways or set screws, and it can be repaired by an ordinary mechanic.

A large number of these controllers have been installed at the makers' works in connection with motors on their live roller gear, skids, and pull-over gears, and in their coggin, billet, axle, beam rail, and ordinary rail mills. The motors used are 30-B.H.P. three-turn series-wound tramway motors, capable of withstanding large over-loads, and it is considered that this is a most severe test, as these motors have to be started and reversed under full-load hundreds of time daily, and there is also a tremendous amount of metallic dust and dirt to contend with. The same pattern of

ontroller is being used for the control of their electrical travelling ranes, breaking derricks, falling weight testing machines, &c.

The electrical circuit is made and broken on the liquid. and a special short-circuiting contact is arranged projecting from the side of the tank for cutting out the liquid resistance; thus removing all possibilities of "sparking" on the reversing switch rings and contacts.

Special attention has been given to the construction of the tank which contains the liquid, to ensure good insulation, freedom from splashing and steady control. There are cast on the tanks small pockets to receive the insulation and to prevent the vapour acting detrimentally on the insulation between the dipping plates, supports, and the tank.

The figures given herewith illustrate the construction of the controller, of which the following is a description.

Three concentric brass rings, AAA, are supported upon short legs, B, resting upon and secured to an enamelled slate base, C; the second or intermediate ring is divided by cutting out a short portion on opposite sides, the spaces so made being filled in with some non-conducting material.

The switch contact boxes, E, are carried by two arms of unequal length, F_1 and F_2, mounted on a central vertical shaft, G, on the top of which is fixed a hand wheel, H, by which the switch is operated. These contact boxes travel in annular spaces, I, between the rings, AA. That upon the short arm, F_1, travels between the central divided ring and the smaller ring; that upon the long arm, F_2, travels between the central divided ring and the outside ring shown in fig. 1. The contact pieces, J, carried in the contact boxes, E, are pressed against the opposite sides of the rings by the action of a spring placed between them.

The dipping tank, K, is fixed below the base, C, which supports the switch rings, A; it is provided with lips, N, to prevent water splashing over when the switch is used upon travelling cranes and other moving machinery.

The dipping plate, O, has a vertical movement through a suitable guide, P. It is raised and lowered by means of a roller, Q, carried upon the upper end of the guide rod, R, which engages between the two opposite edges of an inverted crescent-shaped slot, S, in the periphery of a cylinder, T, carried by the central shaft, G, before mentioned.

The central portion of the slot is its highest point; therefore, when the wheel, H, is turned so as to bring the contact pieces to rest against the insulating blocks, D, on each side of the middle ring, the current is cut off from the outside and inside rings, the

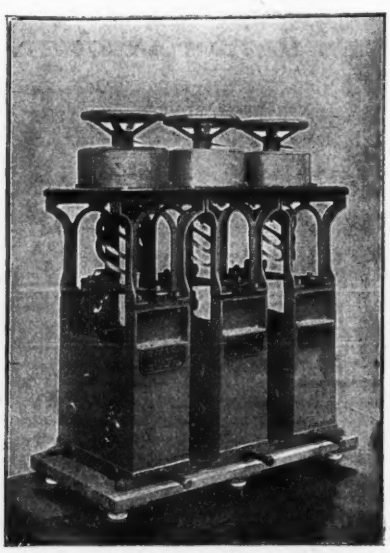


FIG. 3.—SET OF THREE CONTROLLERS.

roller, Q, will also have been raised to its highest point of travel in the groove and the dipping plate raised out of the liquid. If the hand wheel is now turned to the right or left the dipping plate descends.

The contacts are so connected that the current always flows through the fields of the motor in the same direction, but when the switch is turned to the right or left, as the case may be, the direction of the current in the armature is reversed.

There are a number of advantages to be gained by installing liquid resistance controllors in the place of metallic, viz.: They are free from burn-outs, overheating, sparking, and irregular steps; also the required resistance can be got by altering the density of the liquid and the shape of the dipping plate, and such controllers are suitable for controlling motors of any horse-power at any voltage up to 900 volts.

The repairs and maintenance are practically nil, as the only wearing parts are the dipping plates and short-circuiting contacts; these can be changed in a few minutes at a nominal cost, and when used for controlling motors on crane work will last for a very long time. The only attention necessary is the addition of an occasional supply of liquid to make up for evaporation.

ELECTRICAL COMPANIES AND THE LAW OF NEGLIGENCE.

[FROM OUR LEGAL CONTRIBUTOR.]

A CASE is reported in a recent number of the Law Reports which is of some interest to contractors who undertake the laying of electric railways, or the erection of generating stations. In the course of operations, every part of the work has to be inspected by an engineer on behalf of the company or corporation for whom the contractors are working. If the engineer or inspector wishes to carry out the work thoroughly, he must expose himself to the risk of accident. If an accident occurs, the question at once arises whether the contractors are liable to pay damages for the injuries which result. This problem arose in a concrete form, and was decided in the Court of Appeal at the end of the last sittings.

The defendant was contractor for making a tunnel for a tube railway, and had constructed, for the purpose of carrying out the work, a temporary line on which an electric locomotive ran. This locomotive was used to draw trucks containing the excavated material to a spot where it could be brought to the surface. It was not fitted for passengers, and the defendant had directed that no one should be allowed to ride on it but the driver and a guard. It had, however, been used to carry officials in the employment of the defendant and of the railway company, with the knowledge and concurrence of the defendant's representative. The plaintiff was an inspector of works appointed by the engineer of the railway, and he accepted from the defendant's timekeeper, who was riding on a locomotive, an invitation to be conveyed by it to his destination. An accident happened while the plaintiff was on the locomotive, and he sustained injuries. In an action to recover damages from the defendant in respect of these injuries, the jury found that the plaintiff was on the locomotive for his own convenience, but with the permission of the defendant's representative, and that the accident was due to the negligence of the defendant's servants. It was decided by the Court that the defendant must be taken, through his representative, to have permitted the plaintiff to ride on the locomotive, and that his liability was that of a person who undertakes the carriage of another gratuitously; that the duty in such a case is that the care exercised must be reasonable under the circumstances; that there was evidence of such a failure of due care on the part of the defendant's servants as would make him responsible for damage arising therefrom; and that the plaintiff was entitled to judgment.

At first blush it may not appear that the relationship between the inspector and the contractor was such as to justify his bringing successful suit against him in these circumstances; but a glance at some earlier cases which deal with the liability of a person to make good any damage sustained by bare licensee on his premises will serve to show that the law has been correctly interpreted.

In another case it appeared that the plaintiff sent a heifer (which was put into a horsebox) by rail to a certain station. When the train arrived at the station, there were only two porters available to shunt the horsebox to the siding, from which alone the heifer could be delivered to the plaintiff. In order to save delay the plaintiff assisted in the shunting operations, and while so employed he was run against and injured by a train being negligently allowed by the defendants' servants to come out of the siding. There was evidence that the station-master knew that the plaintiff was assisting in the shunting and that he assented to his doing so. It was decided in the Court of Appeal that the plaintiff was not a mere volunteer assisting the defendants' servants, but was on the defendants' premises with their consent for the purpose of expediting the delivery of his own goods, and the defendants were therefore liable to him for the negligence of their servants. It will be seen that this is a parallel case to that of the inspector; for in allowing the owner of the heifer to assist in the loading, the railway company impliedly undertook to exercise reasonable care so as not to inflict any injury upon him.

The distinction to be observed between the liability of those who carry passengers or goods and those who merely

allow persons to come upon their premises will be apparent to anyone who compares the above case with that of Gautret *v.* Egerton (L.R. 2 C.P. 371). In that case the defendants were possessed of a piece of land with a canal and cuttings intersecting the same, and of bridges across the canal, and cuttings communicating with and leading to certain docks, which land and bridges were used with their consent and permission by persons proceeding to and coming from the docks. It was alleged that they wrongfully and improperly kept and maintained the land, canal, cuttings and bridges, and suffered them to be in so improper a state and condition as to render them unsafe for persons lawfully passing along and over the land and bridges towards the docks. The plaintiff, who was lawfully passing over and using the bridges, through the negligent conduct of the defendants, fell into one of the cuttings and was drowned. It was decided by the Court that the defendants had not been guilty of any actionable breach of duty.

Again, in the case of Ivay *v.* Hedges (L.R. 9 Q.B. 80), the defendant was the landlord of a house which was let out in apartments to several tenants, each of whom had the privilege of using the roof (which was flat and covered with lead, having an iron rail on its outer edge) for the purpose of drying their linen; the access to the roof being by means of a low door at the stair-head about 2 ft. from the rail. The plaintiff, who occupied one of the rooms, went upon the roof for the purpose of removing some linen, when, his foot slipping and the rail being out of repair (and known by the landlord to be so), he fell through to the courtyard below and was injured. It was decided that the mere license to the lodgers to use the roof as a drying ground imposed no duty upon the defendant to fence it or to keep the fence in repair.

The above principles were clearly adopted by the Master of the Rolls in the case under review, when he said:—

"There is an obvious difference between the measure of confidence reposed and responsibility accepted in the case of a person who merely receives permission to traverse the premises of another, and in the case where a person or his property is received into the custody of another for transportation."

To point the moral of this case, we may consider what would the position be if the accident had occurred in another way. Suppose, for instance, the inspector had stumbled over something in the tunnel and injured his leg; in that case the contractors could not have been held liable. So it is conceived if an inspector visiting a generating station suffered from a fall, he could make no valid claim against those who were erecting the building.

THE BOROUGH COUNCIL ELECTIONS.

[COMMUNICATED.]

Next month the municipal parliaments will be elected, and it is to be hoped that more general interest will be taken in them than is usually the case. There appears to be more disposition on the part of large ratepayers to check the extravagances which have arisen out of the growth of socialistic principles in local governing bodies, and this may lead to improvement in the constitution of the councils.

In the provinces, the local elections have always been conducted upon more or less political lines; to such an extent, indeed, that the results of the contests have been received as indications of public opinion upon Imperial affairs, and in recent times similar party spirit has been promoted in the metropolitan boroughs.

At the elections in 1900, it was a common thing to see such an announcement as the following, in the colours of the party appealed to for support:—"Vote for Blankinsense, the Unionist and Moderate candidate, supported by the Conservative Associations." Not a word is there here about the fitness of the aspirant for municipal honours to deal with such mere local matters as drainage, repair, maintenance and lighting of thoroughfares, administration of Building and other Acts for protection of the inhabitants, prevention of food adulteration, and sanitary precautions. All such matters are ignored, and the vote given not to secure efficiency in local management, but merely the creation of centres of influence for a political party.

As it has been pointed out, the duty of the authorities is to keep their districts clean and healthy, and to see that household necessaries are good and wholesome, and if the management of the elementary schools is added to the work of the borough councils, the assistance of women on the councils will become of essential importance.

Among the burning questions at the forthcoming elections, municipal trading will be most prominent, and the results of the electric supply and tramway undertakings will be among the most interesting facts for the ratepayers.

In the borough of Lewisham, the extension of tramways is the question upon which the elections are likely to turn, and in this case the issues are somewhat complicated.

It is peculiar that while the tramways in the south of London are in the hands of the London County Council, those in the north of the metropolis are managed by private enterprise, with the result that, so far as the ratepayers are concerned, the financial results are decidedly against the muncipal trading; but, as the extension of the tramways in Lewisham is strongly desired by a large section of the community, they will vote for the candidate who supports them, whether municipally worked or not; but, opposed to this section, are those who object to the speculation at the risk of the ratepayers, while favouring the improved means of communication so essential to the convenience of the borough.

The London County Council are ready to carry out an extensive scheme, involving a large sum for street widenings, which many ratepayers would prefer to be provided by a private company rather than out of their own pockets.

The position of Marylebone with respect to the electric lighting undertaking will no doubt exercise a salutary influence on the ratepayers at the approaching election, and prompt more interest in local management than heretofore. As matters at present stand, the advocates of municipal trading have landed the ratepayers in a liability of 18s. in the £, which, if levied, would raise the rates to 24s. in the £. In this instance, playing with edge tools has proved a dangerous proceeding, and no doubt the lesson will be taken to heart.

As the *Municipal Journal* says: "To run a candidate who is in favour of the electric lighting undertaking will apparently be to court disaster, and yet the enterprise *must* be carried on by the local authority;" and they add, "was there ever such a muddle in political municipal elections?"

It is certainly a case of locking the stable door after the horse is stolen; but it is an object lesson which will not be lost on ratepayers, and it may probably encourage them to do their duties as citizens more effectively than in the past.

If ratepayers in each of the municipalities would employ a local accountant to get out a statement of the financial result of their electric supply undertakings, basing the accounts upon the sound system of providing for depreciation, obsolescence, and a fair proportion of the town clerk's, borough surveyor's and other establishment expenses, it would do more to put an end to further municipal trading than all the theories of its opponents. The breeches pocket argument is a mighty one, the most unsound policy being tolerated if it is supposed to pay; while money can be borrowed *ad libitum*, and loans piled up, reckless trading is permitted; but ask the ratepayers to pay directly for the luxury, and then, like Marylebone, the advocates of such enterprises are at a discount.

Let a start be made with the electricity accounts of the boroughs of Hackney, Hammersmith, Hampstead, Islington, Shoreditch, Southwark, Stepney and St. Pancras, and we venture to say that the results will satisfy prudent ratepayers that this municipal trading has added to their burdens and liabilities, besides infringing upon the sound principle of limiting municipal authorities to the domestic business, which is their proper sphere.

According to the tables of the *Electrical Times*, the aggregate accounts of the eight metropolitan boroughs who have published their annual statements show the following as the result of their electrical undertakings:—

Total expenditure		£1,965,650
Revenue	£248,090	
Costs	136,797	
Gross profit ...	£111,293	
Interest ...	£56,204	
Sinking fund...	28,123	
	84,327	
Surplus claimed	£26,966	

Upon the capital outlay, even deducting the repayment of loans, the surplus would only amount to 2·8 per cent., but this would more than disappear if the most moderate provision were made for depreciation.

We commend these figures to the ratepayers at the approaching elections.

The Telegraph Wire Export Trade.—A very quiet tone continues to rule in the export trade of this country in telegraph wire and apparatus connected therewith. The shipments during September only amounted to £44,097, as compared with £62,272 in August last, and £50,739 in September of last year. The depression which has ruled this year in this branch of the exported trade is well shown by the figures for the nine months ending with September, during which period the shipments have only attained a value of £1,572,563, which contrasts with £2,226,732 in the corresponding nine months of 1902.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

20,788. "Improvements in or relating to electric arc lamps." A. D. Jones. September 28th.

20,791. "Improvements in terminals for wiring motors or any other electrical appliances." E. H. Ainsworth. September 28th.

20,798. "Improved electric fish masses, or shoal of herrings indicating device." J. Eggen. September 28th. (Complete.)

20,806. "Coherers for Hertzian wave telegraphy." V. W. Delves-Broughton. September 28th.

20,820. "Improvements in or relating to electric machines." H. Chitty. September 28th.

20,825. "Improvements in and relating to electric lamps." W. C. Head and W. A. Snape. September 28th.

20,834. "Improvements relating to lamp casings and reflectors principally for incandescent electric lamps." D. J. O'Brien and T. A. Rottanzi. September 28th.

20,886. "Improvements in or relating to disinfecting fabrics and articles particularly applicable for telephonic and other apparatus." A. J. Boult. (C. Fuchs and H. C. Kelterer, Belgium.) September 28th.

20,875. "Improvements in electric lamp holders and means for securing shades or globes thereto." J. T. Lambert. September 29th.

20,889. "Improved process and apparatus for the electrolysis of chlorides of the alkalies." C. Kellner. September 29th. (Complete.)

20,907. "Improvements in telegraph systems." C. K. Jones. September 29th. (Complete.)

20,921. "Improvements in insulated electric conductors and method of producing the same." J. A. Heany. September 29th. (Complete.)

20,926. "An improved electric current converter." A. R. Müller. September 29th. (Complete.)

20,933. "Improvements in contact trolleys for electric tramcars and the like." A. Domanski. September 29th.

20,934. "Improvements in electric switches, bell pushes or fittings, and the like." F. E. Dotchin. September 29th.

20,989. "Improvements in or relating to electrolytic electricity meters." The Bastian Meter Co., Ltd., and C. O. Bastian. September 30th.

21,005. "Improvements in and relating to alternating current electric motors." The British Thomson-Houston Co., Ltd., and H. S. Meyer. September 30th.

21,008. "Improvements in mounting a number of electrical fittings or instruments upon a common base or panel." R. W. H. Hofstede-Crull. September 30th.

21,016. "Improvements in or relating to alternate current measuring apparatus." A. F. Berry. September 30th.

21,027. "Improvements in and relating to electricity meters." W. Hamilton. September 30th.

21,043. "Electro-magnetic trolley-rope check." R. N. Eaton. October 1st.

21,054. "Improvements in rheostats." H. M. Hobart and F. Punga. October 1st.

21,055. "Improved methods of collecting currents of electricity in connection with a conduit system of tramways." F. J. Anson and J. W. Anson. October 1st.

21,067. "Improvements in electric motors." J. H. Kaye. October 1st.

21,078. "An improved party line telephone system." H. C. Heide. (G. A. Lowry, United States.) October 1st.

21,088. "Improvements in and connected with telephone connections on the party line system." H. Oppenheimer. (Actiengesellschaft Mix & Genest, Germany.) October 1st.

21,090. "Improvements in or relating to dynamometers for electric currents." A. J. Boult. (M. E. Turner, United States.) October 1st.

21,093. "Improvements in or relating to electrical switches (and their analogues)." J. Porter. October 1st.

21,104. "An improved electrolyte for electric batteries, and method of preparing the ingredients composing said electrolyte." A. Blackman and C. E. Warren. October 1st.

21,127. "Improvements in controllers for electric motors." G. Forbes. October 1st.

21,153. "A splicing fitting for splicing or jointing trolley wires, cables, wire ropes and metal rods, of any description." A. R. Dayson. October 2nd.

21,173. "An electro-mechanical arrangement for changing speed or for reversing the direction of the engine." P. J. M. Gasnier. October 2nd.

21,194. "Improvements in or relating to the method of transmitting printing telegraphic messages over long lines, and to the apparatus therefor." A. Battaglia-Guerrieri. October 2nd. (Complete.)

21,216. "Improvements in electric railway systems." W. M. Eader. October 2nd. (Complete.)

21,261. "A new or improved device for use in connection with the trolleys of electric tramcars." G. H. Babb. October 3rd.

21,294. "Improvements relating to dynamo-electric machines, and electric motors." E. A. Fagerlund. October 3rd.

21,302. "Improvements in automatic telephonic installations." B. Kugelmann. October 3rd.

21,304. "Improvements in driving electrical machines by means of steam turbines." Siemens Bros. & Co., Ltd. (Siemens & Halske Actien-Gesellschaft, Germany.) October 3rd. (Complete.)

21,305. "Method of and apparatus for maintaining uniform speed in electric motors." Siemens Bros. & Co., Ltd. (Siemens & Halske Actien-Gesellschaft, Germany.) October 3rd. (Complete.)

21,306. "Improvements in electric lamps." J. B. B. Burke. October 3rd. Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1902.

4,463. "An improved electric switch." H. Faraday. Dated February 21st.

4,520. "Improvements in or relating to electric batteries." V. G. Apple. Dated February 22nd.

4,623. "Method of cutting out large quantities of electrical energy in particular when of high voltage." Siemens Bros. & Co. (Siemens & Halske Aktiengesellschaft.) Dated February 24th.

4,624. "Cutting out contact devices for electric circuits." Siemens Bros. and Co. (Siemens & Halske Aktiengesellschaft.) Dated February 24th.

4,648. "Improvements in electrical out-outs or fuse boxes, feeder pillars and other devices for the interconnection of a number of conductors." F. A. Pocklington. Dated February 24th.

4,650. "Improvements in signalling systems for electric railroads." O. W. Hart. Dated February 24th.

4,729. "Improvements in and relating to electric incandescence lamp-holders." C. E. Knowles. Dated February 25th.

4,754. "Improvements in field magnets for dynamo-electric machines or electric motors." R. Lundell. Dated February 25th.

4,755. "Improvements in incandescent electric lamps." E. McOuat. Dated February 25th.

4,763. "Improvements in arc lamps." W. Crudgington. Dated February 25th.

11,160. "Improvements in electric arc lamps." A. Kirby and A. J. Kirby. Dated May 15th.

11,313. "Improvements in and relating to the transmission of electrical impulses." L. Walter and P. Walter. Dated May 16th.

11,324. "Improvements in electricity meters of the kind known as two-rate meters." L. J. Aron and J. W. Flower. Dated May 16th.

11,357. "Improvements in electricity meters." K. Anderson. Dated May 17th.

11,369. "Improvements in electric governing devices." J. J. O'Connor and W. O. S. Hilditch. Dated May 17th.

12,463. "Improvements relating to electrical measuring instruments." E. Weston and A. O. Benecke. Dated May 31st.

15,119. "An improved method of providing copper cables, intended for use as electrical conductors, with solid ends." G. G. M. Hardingham. (Felten and Guilleaume Carlswerk Actiengellschaft.) Dated July 7th.

15,842. "Improvements in electric switches applicable for electrically-driven hoists or other machines." J. C. Etchells. Dated July 16th.

16,041. "Improvements in electrical resistances." A. C. Reyrolle. Dated July 18th.

16,072. "Improvements in electric motors for ceiling fans." W. J. Rollo. Dated July 19th.

16,341. "Improvements in and relating to the prevention of formation of deleterious vapours by electric discharges in the air." H. Viertel and Gebruder Siemens & Co. Dated July 22nd.

16,711. "An improvement in electrical conductors." Siemens Bros. & Co., Ltd., and W. Dieselhorst. Dated July 28th.

16,776. "An electrically operated safety clutch for hoists." U. Horsfall and J. Crowther. Dated July 29th.

16,905. "Improvements relating to contact fingers for electric controllers." H. H. Lake. (General Electric Co.) Dated July 30th.

16,939. "Improvements in or relating to apparatus for electric transmission more particularly adapted for operating and controlling automatic type-setting and composing machines." J. Lagarde. Dated July 30th.

16,984. "Improvements relating to electrodes for secondary batteries." P. A. Gouin. Dated July 31st.

17,384. "Improvements in dynamo-electric machines." H. H. Lake. (General Electric Co.) Dated August 7th.

17,385. "Improvements in means for regulating electric circuits." H. H. Lake. (General Electric Co.) Dated August 7th.

17,389. "Improvements in and relating to the insulation of high potential electrical current." H. H. Lake. (General Electric Co.) Dated August 7th.

17,794. "Improvements in apparatus for actuating the electrical controlling appliances of the motors of electric railway cars." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktiengesellschaft.) Dated August 13th.

18,228. "Improvements in electric switches." H. H. Lake. (General Electric Co.) Dated August 19th.

18,317. "Improvements in electric arc lamps." British Thomson-Houston Co., Ltd. (J. J. Wood.) Dated August 20th.

18,320. "Improvements in controllers for electric motors." British Thomson-Houston Co., Ltd. (Dutton.) Dated August 20th.

18,327. "Improvements in starting devices for electric motors." British Thomson-Houston Co., Ltd. (R. H. Read.) Dated August 20th.

18,322. "Improvements in fuseless rosettes for electric circuits." The British Thomson-Houston Co., Ltd. (Wirt.) Dated August 20th.

18,328. "Improvements in systems of electric motor control." The British Thomson-Houston Co., Ltd. (Case.) Dated August 20th.

18,330. "Improvements relating to armatures for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (Reist.) Dated August 20th.

18,331. "Improvements in means for regulating dynamo-electric machines." The British Thomson-Houston Co., Ltd. (McKay.) Dated August 20th.

18,786. "Improvements in electric arc lamps." H. Bremer. Dated August 26th.

18,922. "Improvements in electric meters." H. H. Lake. (The General Electric Co.) Dated August 28th.

18,926. "Improvements in electrical transformers." H. H. Lake. (The General Electric Co.) Dated August 28th.

18,933. "Improvements in safety appliances or trolley catchers for electric cars." G. C. Miles. Dated August 28th.

19,208. "Improvements in or connected with trolleys for electric traction." S. Roberts. Dated September 2nd.

19,428. "Improvements in electro-magnetic brakes." J. G. Childs. Dated September 4th.

19,563. "Improvements in and relating to electrical switch devices applicable to rheostats, commutators and the like." H. H. Lake. (General Electric Co.) Dated September 6th.

19,688. "Improvements in the carbon feeding and arcing mechanism of electric arc lamps." Veritys, Ltd., and W. R. Ridings. Dated September 9th.

19,689. "Improvements in the carbon feeding mechanism of electric arc lamps." Veritys, Ltd., and W. R. Ridings. Dated September 9th.

19,842. "Improvements in electrical switches." W. A. MacFarlane. Dated September 11th.

19,901. "Improved apparatus for converting variations in the intensity of an electric current into variations in the intensity of light." C. Hulsmeyer. Dated September 11th.

19,985. "Improvements in electricity meters." The British Thomson-Houston Co., Ltd., and Holden. Dated September 12th.

20,240. "Improvements in electric conduit railways or tramways." R. A. Hadfield and D. Galbraith. Dated September 16th.

20,415. "Improvements in terminals for electric wires." The Wolseley Tool and Motor-Car Co., Ltd., and H. Austin. Dated September 19th.

20,483. "Improvements in electric safety fuses." O. L. Peard and F. Dew. Dated September 19th.

20,557. "Improvements in the electrical control of the water supply of lavatories, bath tubs, shower baths and bowls." I. G. Wateman. Dated September 20th.

20,863. "Improvements in means or apparatus for attaching electric sconces and the like to walls, ceiling, and other places." A. van Hooydonk. Dated September 24th.

20,931. "Improvement in automatic electric fire alarms, and generally applicable to heat-operated signalling and controlling devices." R. F. S. Venner. Dated September 25th.

21,090. "Improvements in perforators, more particularly for use with automatic telegraph transformers." J. Gell. Dated September 27th.

21,462. "Improvements in or relating to the detection of electrical oscillations." W. H. Walter and J. A. Ewing. Dated October 2nd.

21,648. "Improvements in the control of the electro-motors on electric railway cars." Siemens Bros. & Co., Ltd., Lydall & Duke. Dated October 4th.

21,881. "Improvements in electric arc lamps." W. J. Davy. Dated October 7th.

22,017. "Improvements in the construction of underground conduits, more especially intended for use in underground electric traction." T. E. Devonshire. Dated October 9th.